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Exploring active and skilful student teacher learning: self-regulated and co-regulated learning in primary teacher education

Emmi Saariaho-Räsänen

ACADEMIC DISSERTATION

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Exploring the active and skilful student teacher learning:
Self- and co-regulated learning in primary teacher education

Keywords: *self-regulation of learning, co-regulation of learning, academic emotions, student teachers, Finnish teacher education, teaching practicum*

Abstract

The aim of this doctoral dissertation is to provide new insights into the dynamics of class student teachers' self- and co-regulated learning in the critical and meaningful learning incidents experienced along their study path. The doctoral dissertation consists of three original studies. In the first two studies the focus was on student teachers' self- and co-regulated learning activities (*Study I*) and the academic emotions embedded in them (*Study II*) during their studies. Student teachers' and pupils' co-regulated learning behaviours in authentic classroom interaction in teaching practicums were investigated in *Study III*. In the dissertation, a qualitative driven approach in which content analysis was used was enriched by quantifying of the qualitative findings. The student teacher cohort in *Studies I* and *II* consisted of 19 primary school student teachers who were at the end of their study path and from whom the semi-structured interview data with retrospective narration and visualisations on the critical learning incidents experiences during their studies were collected. In *Study III* the student teacher cohort consisted of video recordings of 43 primary school student teachers who were in different phases of their studies conducting some of the teaching practicum periods belonging to their teacher studies. The critical incidents (one positively perceived and one negatively) student teacher had chosen from the video was analysed.

The findings from *Study I* showed that student teachers' adapted active self- and co-regulated learning activities in especially positively experienced learning incidents. The regulated learning phases were balanced within and between self- and co-regulated learning. Self-regulated learning activities were adapted in courses calling for individual responsibility in learning (e.g., Thesis seminars) and co-regulated learning emphasised in teaching practicums and courses in which teacher educators had created a supportive yet challenging learning enviroment, i.e. constructive friction for teacher learning. Although co-regulated learning activities were reported less often than self-regulated

activities, were they overall perceived highly significant and instructive experiences in terms of teacher learning.

The findings from *Study II* showed that the majority of student teachers' self- and co-regulated learning activities included positive and activating academic emotions across all regulated learning phases. Enthusiasm and enjoyment were the most commonly reported academic emotions in both self- and co-regulated learning activities. Three main triggers of academic emotions in self- and co-regulated activities were found: 1) facing challenges, 2) social support, and 3) innovative learning and knowledge construction. In co-regulated learning incidents, all three triggers were typically found, whereas in self-regulated learning was commonly one of the triggers emphasised.

The findings from *Studies I* and *II* triggered a closer examination of student teachers' co-regulated learning in the environment that was reported as being highly meaningful in terms of teacher learning, i.e., teaching practicums. The results in *Study III* showed that positively -perceived co-regulated learning incidents embedded in student teachers' and pupils' classroom interaction included more frequently, more proactive, and more varied co-regulated learning behaviours than the negatively perceived incidents. Also, verbal and non-verbal co-regulated behaviours were intertwined. In positively perceived incidents behaviours were typically calm and concentrated, whereas in negatively perceived incidents, behaviours were restless and tensed. Furthermore, positively perceived incidents including co-regulated learning behaviours could be found at the beginning and in the middle of lessons and on on-task phases, whereas negatively perceived behaviours were typically transitional situations between tasks. Accordingly, findings revealed that in positively -experienced learning incidents, student teachers' and pupils' co-regulated behaviours focused on the task, but in negatively perceived incidents, the focus was more on task-management.

This dissertation contributes to the literature on self- and co-regulation in teacher learning by a) offering new insights on how student teachers' regulate their own and others' learning throughout their study path; b) proposing that student teachers' active self- and co-regulation of learning and positive academic emotions are closely related; c) giving fresh insights into the dynamic nature of co-regulated learning as a mediating process when learning how to regulate oneself and others; and d) by examining student teachers' and pupils' actual co-regulated learning behaviours in authentic classroom interaction during teaching practicums.

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Emmi Saariaho-Räsänen

Taitava oppiminen luokanopettajakoulutuksessa:
Opettajaopiskelijoiden oppimisen itse- ja yhteissäätely osana aktiivista opettajaksi oppimista

Avainsanat: *oppimisen itsesäätely, oppimisen yhteissäätely, akateemiset tunteet, luokanopettajaopiskelijat, suomalainen opettajankoulutus, opetusharjoittelu*

Tiivistelmä

Väitöskirjatutkimuksessa tarkasteliin luokaopettajaopiskelijoiden oppimisen itse- ja yhteissäätelyä opintojen aikaina kriittisiksi ja merkityksellisiksi koetuissa oppimistilanteissa opettajakoulutuksessa. Väitöskirja koostuu kolmesta itsenäisestä osajulkaisusta. Kahdessa ensimmäisessa osajulkaisussa keskityttiin tarkastelemaan, miten opettajaopiskelijat raportoivat itse- tai yhteissäätelevät oppimistaan opintojensa aikana (osatutkimus I) ja toisessa sitä, millaisia akateemisia tunteita oppimisen itse- ja yhteissäätelyä sisältäneet oppimiskokemukset sisälsivät (osatutkimus II). Kolmannessa osatutkimuksessa tarkasteltiin sitä, miten opettajaopiskelijat ja oppilaat yhteissäätelevät oppimistaan autenttisissa luokkahuonetilanteissa eri opetusharjoitteluissa. Väitöskirja toteutettiin kvalitatiivisella tutkimusotteella ja aineiston analysoitiin laadullisella sisällönanalyysillä, jota täydennettiin laadullisessa analyysissä saatujen tulosten kvantifioinnilla. Opintojensa loppuvaiheessa olevia luokanopettajaopiskelijoita (N=19) haastateltiin heidän opintojensa aikana kokemista kriittisistä oppimiskokemuksista puolistrukturoiduin teemahaastatteluin, hyödyntäen retrospektiivistä narraatiota ja visuaalisia menetelmiä. Eri vaiheissa opintojaan ja eri opetusharjoitteluita suorittavilta luokanopettajaopiskelijoilta (N=43) kuvattiin yksi heidän valitsemasa oppitunti, josta analysoitiin opiskelijoiden itsensä valitsemat kriittiset kohdat, yksi onnitustuneeksi ja yksi haastavaksi koettu luokkahuonetilanne.

Osatutkimuksen I tulokset osoittivat, että opettajaopiskelijat itse- tai yhteissäätelivät oppimistaan erityisesti positiivisiksi koetuissa oppimistilanteissa. Oppimisen säätelyn vaiheet jakautuivat tasaisesti niin itse- kuin yhteissäätelytilanteissa. Opiskelijat raportoivat itsesäätelyä itsenäistä otetta vaativissa oppimistilanteissa, kuten tutkielmaseminaareissa. Yhteissäätelyä taas esiintyi opetusharjoitteluissa ja kursseilla, joissa opettajankouluttajat samanaikaisesti tarjosivat tukea, mutta myös positiivisella tavalla haastoivat opiskelijoita ja tarjosivat rakentavan jännitteen oppimiselle. Tutkimuksen tulokset osoittivat myös, että vaikka itsesäätelyä

sisältäneitä kriittisiä oppimiskokemuksia raportoitiin enemmän, koettiin yhteissäätelyä sisältäneet erittäin merkityksellisiksi ja opettajuutta kehittäneiksi oppimiskokemuksiksi.

Osatutkimuksen II tulokset osoittivat, että suurin osa opettajaopiskelijoiden itse- tai yhteissäätelyä sisältäneistä oppimiskokemuksista sisälsi positiivisia ja aktivoivia akateemisia tunteita kaikissa oppimisen säätelyvaiheissa. Yleisimmät tunnistetut tunteet olivat innostus ja ilo sekä itse- että yhteissäätelyssä. Oppimisen itse- ja yhteissäätelyä sisältäneissä kriittisissä oppimiskokemuksissa akateemisia tunteita virittivät 1) haasteiden kohtaaminen, 2) sosiaalinen tuki ja 3) innovatiivinen oppiminen ja uuden tiedon rakentaminen, joista kaikki kolme tyypillisesti esiintyivät yhteissäätelytilanteissa kun taas itsesäätelyä sisältäneissä oppimiskokemuksissa yksi näistä, esimerkiksi haasteiden kohtaaminen, painottui.

Osatutkimuksen III tulokset osoittivat, että ne oppimistilanteet, jotka opettajaopiskelijat olivat kokeneet onnistuneiksi, sisälsivät aktiivisempaa ja vastavuoroisempaa yhteissäätelyä oppilaiden kanssa kuin ongelmalliseksi koetut oppimistilanteet. Tämä näkyi myös verbaalisessa ja non-verbaalisessa kanssakäymisessä. Positiiviksi koetuissa luokkahuonetilanteissa opettajaopiskelijoiden ja oppilaiden käyttäytyminen ja keskustelu oli tyypillisesti rauhallista ja keskittynyttä kun taas negatiivisesti koetuissa levotonta ja jännitteistä. Oppimisen yhteissäätelyä sisältäneet positiiviseksi koetut oppimistilanteet sijoittuivat usein tunnin alkuun tai keskelle ja niissä keskityttiin tehtäväntekovaiheeseen, kun taas vastaavasti yhteissäätelyä sisältäneet negatiiviseksi koetut oppimistilanteet olivat tyypillisesti siirtymätilanteita tehtävien välillä. Positiiviksi koetuissa oppimistilanteissa opettajaopiskelijoiden ja oppilaiden yhteissäätely keskittyi itse tehtävään ja opiskeltavaan asiaan, kun taas negatiiviseksi koetuissa tehtävän hallintaan.

Tämä väitöskirjatutkimus edistää luokanopettajaopiskelijoiden oppimisen säätelyn kohdistuvaa tutkimusta seuraavasti: a) avaa uusia näkökulmia siihen, miten luokanopettajaopiskelijat koko opintojensa aikana säätelevät oppimistaan yksin ja yhdessä, b) osoittaa miten luokanopettajaopiskelijoiden aktiivinen oppimisen itse- ja yhteissäätely on yhteydessä positiivisiin akateemisiin tunteisiin, c) tarjoaa tuoreen näkökulman oppimisen yhteissäätelyyn dynaamisena prosessina, joka mahdollistaa itse- ja sosiaalisten säätelytaitojen oppimisen, ja d) tarkastelee ensimmäisten joukossa luokanopettajaopiskelijoiden ja oppilaiden yhteissäätelyä autenttisissa luokkahuonetilanteissa opetusharjoittelussa.

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Home at Littoinen Verkatehdas, August 2020.

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LIST OF ORIGINAL ARTICLES

This doctoral dissertation is based on the following three original publications, which are referred to in the text according to Roman numerals (I–III):

I. Saariaho, E., Pyhältö, K., Toom, A., Pietarinen, J., & Soini, T. (2016). Student teachers' self- and co-regulation of learning during teacher education. *Learning: Research and Practice*, 2(1), 44–63. doi: 10.1080/23735082.2015.1081395

II. Saariaho, E., Anttila, H., Toom, A., Soini, T., Pietarinen, J., & Pyhältö, K. (2018). Student teachers' emotional landscapes in self- and co-regulated learning. *Teachers and Teaching: theory and practice*, 24(5), 538–558. doi: 10.1080/13540602.2018.1430565

III. Saariaho, E., Toom, A., Soini, T., Pietarinen, J., & Pyhältö, K. (2019). Student-teachers' and pupils' co-regulated learning behaviours in authentic classroom situations in teaching practicums. *Teaching and Teacher Education*, 85, 92–104. doi: 10.1016/j.tate.2019.06.003

The research for this dissertation has been carried out as a part of the Learning and Development in School (OPPI) research group. The first author of the articles included in this dissertation, Emmi Saariaho, has been corresponding author in all three articles. She was responsible for designing of the study, analysing the data and writing the articles. Supervisors Kirsi Pyhältö, Auli Toom, Tiina Soini-Ikonen and Janne Pietarinen designed the data collection, supervised the analyses and took part in editing the article manuscripts during the research project.

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1. INTRODUCTION

"*Nihil sine labore"*. The Latin proverb "nothing without work" is the heart of learning, reminding us that although "the road to success may be paved with good intentions, success requires persistent effort" (Randi, 2004, p. 1827). The persistent effort refers to *regulation of learning,* individually (*self-regulation of learning*) and with others (*co-regulation of learning*). Self-regulation of learning (SRL) entails learners having the cognitive and metacognitive skills, motivation, and skills to regulate emotions when mastering their own learning (Pintrich, 1999). SRL has become the core skill to be learned at schools, because it is a key determinant of high-quality learning and good learning outcomes (see e.g., Mega, Ronconi & Beni, 2014; Pintrich, 2004; Zimmerman & Schunk, 2011). Co-regulation of learning (CoRL), on the other hand, refers to the dynamic process in which learning is regulated with others and through which both self and social regulation skills are learned (e.g., Hadwin, Järvelä, & Miller, 2011; Hadwin & Oshige, 2011; Järvenoja, Volet, & Järvelä 2013; Winne, Hadwin, & Perry, 2013). It has been proposed in recent literature that in co-regulated learning individuals may have different positions and different goals set for learning, despite of the intertwined regulation processes (e.g., Volet, Vauras, Khosa, & Iiskala, 2013).

Skills to self- and co-regulate learning enable teachers to support pupils in becoming active and goal-oriented self- and co-regulating learners and developing and deepening their own expertise as teachers (Randi, 2004; Perry & Rahim, 2011). Accordingly, teachers are expected both to scaffold the development of pupils' self-regulation skills and actively co-regulate pupils in order to enhance individually and socially regulated learning and simultaneously take advantage of pupils' regulatory efforts in learning situations (Perry & Rahim, 2011). However, teachers' ability to adapt SRL and CoRL cannot be taken for granted. In fact, previous studies have shown that skills for the regulation of learning should be a more integral part of teacher education and that student teachers are not natural experts in SRL and CoRL (e.g., Endedijk, Vermunt, Verloop, & Brekelmans, 2012; Endedijk, Brekelmans, Verloop, Sleegers, & Vermunt, 2014; Heikkilä, Lonka, Nieminen, & Niemivirta, 2012; Hwang & Vrongstinos, 2002). Student teachers have been shown to benefit from studies in which self-regulation skills are explicitly taught as well as teaching practicums where teacher educators promote their abilities to support pupils' self-regulated learning opportunities (e.g., Kramarski & Michalsky, 2009; Tillema & Kremer-Hayon, 2002; Perry, Phillips, & Dowler, 2004; Perry, Phillips, & Hutchinson, 2006; Perry, Hutchinson, & Thauberger, 2008; Vrieling, Bastiens, & Stijnen, 2010; 2012).

Ability to active SRL has been found to be closely connected to better learning outcomes and to positive academic emotions experienced on the learning situation (e.g., Mega et al., 2014; Pekrun, Goetz, Titz, & Perry, 2002). Successfully co-regulated learning has also been shown to be linked with the positive emotional atmosphere of the classroom or among groups studying together, implying that regulation of learning with others and academic emotions are closely intertwined (e.g., Järvenoja & Järvelä, 2009; Westling, Pyhältö, Pietarinen, & Soini, 2017). On the other hand, negative academic emotions emerging in learning situations tend to hinder learning (Pekrun et al., 2002). Student teachers' regulation of their own and others' learning typically takes place in demanding and complex social situations (such as in teaching practicums), and is therefore an emotional process, including a variety of positive and negative academic emotions (e.g., Anttila, Pyhältö, Soini, & Pietarinen, 2016; 2017; Timoštšuk, Kikas, & Normak, 2016; Timoštšuk & Ugaste, 2012). Studies have detected that experiencing a variety of academic emotions is one of the core elements in meaningful student teacher learning (e.g., Anttila et al., 2016; 2017; Kostiainen, Ukskoski, Ruohotie-Lyhty, Kauppinen, Kainulainen, & Mäkinen, 2018).

For a teacher to be able to deal with the pedagocgial, emotional, and social challenges at school requires constant development of both self- and co-regulation skills. This means that the skills to regulate learning should be acquired during their teacher education in order to make them integral part of the teaching profession (Randi, 2004). Furthermore, there is evidence that regulation of learning and academic emotions are intertwined (e.g., Mega et al., 2014; Pekrun, et al., 2002), but a comprehensive picture of student teachers' self- and co-regulated learning activities and the academic emotions embedded in them throughout teacher training is still lacking. In addition, although teaching practicums are a significant environment for student teachers' to learn how regulate their own and their pupils' learning (e.g., Endedijk et al., 2012; Perry et al., 2004; 2006; 2008), is there still a gap in literature that sheds light on student teachers' and pupils' actual co-regulated learning behaviours in authentic classroom interaction.

My aim in this doctoral dissertation was to understand how Finnish primary school student teachers self- and co-regulate their learning, and to consider the academic emotions self- and co-regulation of learning triggered in the meaningful learning experiences in teacher education. In order to do this, student teachers' self- and co-regulated activities (*Study I*) and the academic emotions embedded in them (*Study II*) were investigated. Further, to deepen the understanding of the dynamic nature of co-regulated learning, student teachers' and pupils' co-regulated learning behaviours in teaching practicums were analysed (*Study III*). The student teachers' self- and co-regulated learning activities were analysed from two qualitative data sets (interviews and video data) in order to deepen the understanding of how

student teachers utilise self- and co-regulated learning in significant learning experiences throughout their studies (SRL and CoRL), and especially in teaching practicums (CoRL). The doctoral dissertation contributes to the literature on self- and co-regulation in teacher learning a) by providing new insights on how student teachers' regulate their own and others' learning throughout their study path; b) by proposing that student teachers' active self- and co-regulation of learning and positive academic emotions are closely related; c) by offering new insights of the dynamic nature of co-regulated learning as a mediating process when learning how to regulate oneself and others; and d) by examining student teachers' and pupils' actual co-regulated learning behaviours in authentic classroom interactions during teaching practicums.

1.1 THE DYNAMIC RELATIONSHIP OF SELF- AND CO-REGULATED LEARNING

It has been suggested that self- and co-regulated learning are the hallmark of skilful learning (Zimmerman & Schunk, 2011; Hadwin et al., 2011). Several positive attributes have been associated with both of them. Self-regulated learning (SRL) has been found to be related to positive academic emotions, better learning outcomes, good grades, and high self-efficacy beliefs (Bandura, 1997; Mega et al., 2014; Pekrun et al., 2002), while co-regulated learning (CoRL) has been shown to be linked with successful collaborative learning experiences and a positive emotional classroom climate (McCaslin, Sotardi, & Vega, 2015; Westling et al., 2017). Both SRL and CoRL entail active and intentional metacognitive adjustment of one's learning activities to the learning environment in order to promote high-quality learning and overcome challenges faced, either individually or with others (Hadwin et al., 2011).

The SRL and CoRL are separate but also intertwined constructs. Studies on SRL provide an understanding of how *an individual* adaptively masters learning by planning, setting goals, monitoring, controlling, and reflecting on one's cognition, behaviour, motivation, and emotions in order to reach their learning goals, while research on CoRL sheds light into how such learning take place together with others (Hadwin & Oshige, 2011; Hadwin et al., 2011). It has been suggested that learning self-regulation skills proceeds from *inter* individual for *intra* individuals (Grau & Whitebread, 2012; Hadwin et al., 2011; Hadwin & Oshige, 2011). From this perspective, enhancement of learning of self-regulation skills is provided by *co-regulation* of learning. Particularly co-regulated learning with more capable ones (e.g. with teachers) is suggested to play a key role in demonstrating and supporting learning of self-regulation skills (Hadwin et al., 2011; Hadwin & Oshige, 2011; Järvenoja & Järvelä. 2009).

Traditionally, CoRL has been seen as entailing a temporary distribution of regulation of learning between the learner and (usually) someone more capable – typically a teacher or peer – in a transition process through which the learner internalises self-regulated learning skills within a shared problem-solving situation (Hadwin et al., 2011; Hadwin & Oshige, 2011). It has been suggested in the recent literature that CoRL can also take place as a reciprocal process through which each learner intentionally regulates the learning to the benefit of themselves or others (e.g., each other's cognitive actions and emotional states), i.e., individuals can assist one another's regulated learning activities (Järvenoja et al, 2013; Winne et al., 2013). High-level –CoRL entails making decisions and sharing thoughts together in order to combine various kinds of expertise and shared control of the task (Hadwin et al., 2011). Occasionally learners displaying CoRL may also coordinate their actions by having a shared purpose in mind, and hence engage in highly demanding and complex, but desirable mode of learning, i.e., *socially shared regulation of learning* (SSRL) in which both the learning goals and processes are shared (Järvenoja et al., 2013). Howeve, genuine SSRL is a very challenging even for experts and without appropriate regulation skills, it is rarely reached (Hadwin et al., 2011). This study embraces the reciprocal view of CoRL in which each participant's' self-regulatory learning skills develop, although their learning goals and efforts might be different (Hadwin et al., 2011; Hadwin & Oshige, 2011; Volet et al., 2013) in order to understand how student teachers learn skilfully with others (including teacher educators, peers, and pupils) during teacher education.

SRL and CoRL differ in terms of individual or shared goals and aims in the learning situation. SRL has an intra individual focus while the CoRL takes place at the inter individual level. Yet even in CoRL the learners may have various kinds of goals and hopes for their learning, while still sharing the process (CoRL). In the rare cases of socially shared regulation of learning (SSRL), they even share both the goals and processes through which they aim to reach shared output (see e.g., Hadwin et al., 2011). Both SRL and CoRL are needed in skilful learning. However, in this dissertation it is suggested that the latter can provide a bridge between SRL and SSRL. In CoRL individuals regulate themselves by adjusting their own learning and way of being in the social situation. They also support others in regulating their own learning, towards either different or shared goals set for learning. Accordingly, inspired by the literature of regulated learning (see e.g., Hadwin et al., 2011 and Schoor et al., 2015) it is hypotized in the theoretical model (below) that CoRL can be seen as a mediating wheel that can feed into both the SRL and SSRL activities going on (see Figure 1). Yet empirical evidence on this regards is still lacking.

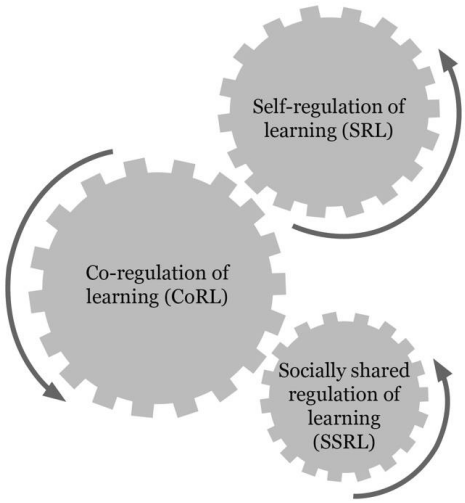

Figure 1. *The dynamics between self-, co-, and shared regulation of learning*

1.2 THE STRUCTURE OF SELF- AND CO-REGULATED LEARNING: DIMENSIONS AND PHASES

Both self- and co-regulation of learning entails regulation of *cognition*, *behaviour*, *motivation*, and *emotions* when attaining either personal or mutual learning goals. The main difference is that in SRL an individual learner is responsible for the whole process, whereas in CoRL participants can support and guide each other's cognitive, behavioural, motivational, and emotional regulation.

Regulation of *cognition* refers to management of the content of the learning task by operating on the experiences the learning environment offers to construct information from it, and further, constructing knowledge from the information (Winne, 2011). This entails selection and use of various cognitive strategies, such as memorising and solving problems (Pintrich, 2004), as well as *metacognitive* monitoring and controlling of one's cognitive operations either individually (SRL) or in collaboration with others (CoRL) (Hadwin et al., 2011; Winne, 2011). Regulation of *behaviour* refers to the overt demeanours that can be carried out individually or with others for reaching the learning goals and maintaining the optimal learning environment, such as time management and help-seeking from others in problematic situations (Pintrich, 2004). Regulation of *motivation* includes adjustment of various motivational beliefs, such as self-/collective-efficacy, personal or mutual perceptions of task difficulty and task value beliefs affecting in the learning situation (Pintrich, 2004; Pintrich & Schunk, 2002; Wolters, 2003).

Regulation of *emotions* during learning entails learner(s) intentional monitoring, controlling, and evaluating a particular emotional experience by changing, avoiding, or terminating the intensity or duration of the emotion (Boekaerts, 2011; Pekrun, 2013). Prior research has further shown that individual learners' ability to regulate emotions is socially embedded and associated in academic achievement (Pekrun et al., 2002). In this dissertation, student teachers' self- and co-regulated learning is explored in terms of the self- and co-regulated activities employed during teacher education. The focus was on analysing the self-reported self- and co-regulated activities and emotions embedded in them and co-regulated behaviours employed in the classroom. Accordingly, the aim was not to concentrate on a specific regulation dimension, but the purpose was to find out how student teachers' regulated learning activities were constructed as personal learning experiences (*Studies I* & *II*) and in overt behaviours which were focused on learning with pupils in teaching practicums (*Study III*).

Both SRL and CoRL include three complementary phases throughout which cognition, behaviours, motivation, and emotions in learning are regulated: (1) preparatory or preliminary phase, (2) performance or on-task phase, and (3) appraisal or adaptation phase (Puustinen & Pulkkinen, 2001). These phases can be conducted either individually, as in SRL, or in collaboration with others, as in CoRL. The *preparatory* phase refers to setting goals for learning and analysing the forthcoming task and thus involves awareness of the task, planning how to proceed with the task, and setting learning goals either individually or in collaboration (Puustinen & Pulkkinen, 2001). The *performance* phase includes active, self-directed (SRL) or mutual (CoRL), monitoring and controlling, for instance, cognition, motivation, and emotions during learning, use of appropriate and diverse learning strategies and changing strategies if needed (Zimmerman, 2000). The *appraisal* phase comprises reflecting on the learning experience, consisting of either self-evaluation (SRL) or co-evaluation (CoRL) of the previous regulatory learning activities, and how they have been performed, this is assessing the learning strategies used as well as achieved learning outcomes (Vermunt & Verloop, 1999; Wigfield, Klauda, & Cambria, 2011; Zimmerman, 2002). Regulated reflection is not only about looking back, but it also entails improving the overall performance in the future (Winne, 2011).

However, neither self- nor co-regulated learning are necessarily linear (Endedijk et al., 2012; Pintrich, 2004; Rogat & Linnenbrink-Garcia, 2011; Van Eekelen, Boshuizen, & Vermunt, 2005): the phases do not follow sequentially each others, that is, they appear non-linearly and change dynamically back and forth during regulated learning both in SRL and CoRL (Pintrich, 2004; Puustinen & Pulkkinen, 2001). There is also evidence that student teachers' SRL is characterised by spontaneous acts, i.e., back and forth moving regulation processes occurring in both formal and informal learning situations

(Endedijk et al., 2012). On the other hand, utilising regulated learning in rich and creative way has been shown to be beneficial in collaborative learning tasks: groups capable of synergic and high-level utilisation of regulated learning (e.g., planning, monitoring, and behavioural engagement), were more successful in achieving their learning goals, compared to groups which were able to regulate only at the narrow level (Rogat & Linnenbrink-Garcia, 2011). Furthermore, a strong determinant in facilitating active and intentional SRL and CoRL is positive socioemotional interactions between the learners (Rogat & Linnenbrink-Garcia, 2011; Volet, Summers, & Thurman, 2009).

1.3 EMOTIONS IN SELF- AND CO-REGULATED LEARNING

Research on regulation of learning has focused on cognitive processes to a great extent, yet emotions play a central role in both SRL and CoRL (Pekrun, 2014; Pekrun et al., 2002; Järvenoja, Järvelä, & Malmberg, 2017; Webster & Hadwin, 2015). More specifically, *academic emotions* (i.e., emotions experienced when learning and teaching), have been found to be related in self- and co-regulated learning (Pekrun, 2014; Schutz & Pekrun, 2007). A positive relationship between positive academic emotions and high-quality SRL and CoRL have been detected, while negative emotions experienced in the learning situation might hinder circumstances for optimally regulated learning (Pekrun et al., 2002; Webster & Hadwin, 2015; Westling et al., 2017).

Academic emotions are intense and short-lived active reactions that arise as responses to stimuli, and when compared with long-lasting moods, they are clearly dependent on the object of activity (Schutz, Hong, Cross, & Osbon, 2006). Academic emotions are multidimensional constructs and include an affective core, physiological, and expressive features, as well as cognitive and motivational components (Frenzel & Stephens, 2013). Furthermore, academic emotions are constructed from two fundamental dimensions, which are *valence*, i.e., positive and negative emotions, and *arousal*, i.e., physiologically activating or deactivating states (Feldman Barrett & Russell, 1998; Pekrun, 2006). Emotions are bipolar by nature and can be categorised in a two-dimensional space where they can be placed within four broad categories: *positive activating* (e.g., enthusiasm), *negative activating* (e.g., anxiety), *positive deactivating* (e.g., relief) and *negative deactivating* (e.g., boredom) (Pekrun 2006). There exists also a few *neutral* emotions (e.g., sadness) which are characterised as being neither activating nor deactivating (Linnenbrink, 2007).

Academic emotions arise from appraisals about perceived successes when attaining goals, or maintaining standards or beliefs during learning and teaching activities (Schutz et al., 2006). Previous research has shown that Finnish student teachers are typically highly committed and engaged when

learning to become teachers and that their learning during their teacher education includes a variety of positive and motivationally related academic emotions (Anttila et al., 2016; 2017). Accordingly, *achievement emotions* play a central role in student teachers' self- and co-regulated learning (Hascher & Hagenauer, 2016; Pekrun et al., 2002; Timoštšuk et al., 2016). In Pekrun's (2006) control-value theory of achievement emotions learners' cognition, emotions, and motivation comprise a constant cycle. Student teachers' affective appraisals of their perceived personal control in the learning situation and the value given to learning are the core elements in the arousal of achievement emotions (Pekrun, 2006). There are two types of achievement emotions: (1) *outcome* emotions concerning the outcomes of achievement-related activities, including prospective anticipatory emotions (e.g., hope for success) and retrospective outcome emotions (e.g., pride of success), and (2) *activity* emotions focusing on the learning actions itself, such as experiencing excitement when learning (Pekrun, 2006). Positive achievement emotions, like enjoyment are found to be positively associated in the use of SRL strategies and better academic achievement (Pekrun & Linnenbrink-Garcia, 2012). Student teachers have been shown to experience activity emotions often in their studies and enthusiasm and interest are frequently reported by student teachers (Anttila et al., 2016; Timoštšuk & Ugaste, 2012). Such positive emotions are beneficial for learning because they tend to broaden students' cognitive and social activity, which further promote creativity in learning (Fredrickson, 2004; Rowe, Fitness, & Wood, 2014). Furthermore, teacher enthusiasm, both experienced and displayed, has been found to resonate in high-quality teaching as well as in pupils' enjoyment and interest while learning (see e.g., Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009; Keller, Goetz, Becker, Morger, & Hensley, 2014; Keller, Becker, Frenzel, & Taxer, 2018; Kunter, Klusmann, Baumert, Richter, Voss, & Hachfeld, 2013). Learning to become a teacher is demanding and student teachers face challenges resulting also negative academic emotions (Anttila et al., 2016; Järvenoja & Järvelä, 2009; Litmanen, Lonka, Inkinen, Lipponen, & Hakkarainen, 2012; Timoštšuk et al., 2016). However, activating negative emotions can also benefit student teachers' learning: mild feelings of exhaustion and anxiety are shown to improve student teachers' learning outcomes compared to feeling carefree (Ketonen & Lonka, 2012; Litmanen et al., 2012; Timoštšuk et al., 2016). Collaborative learning tasks including high-level CoRL or SSRL have also found to be emotionally challenging for student teachers, and emotional balance within the group as well as well-proceeded regulation processes can be easily disturbed by, for instance, in case of disagreement during a group task (Järvenoja & Järvelä, 2009; 2013).

Accordingly, previous studies have suggested that the diversity and the tone of the academic emotions experienced when studying to become a teacher are meaningful in terms of teacher learning as they direct activities towards or

away from learning, i.e., prevent or support optimally self- and co-regulated learning (Anttila et al., 2016; 2017; Kostiainen et al., 2018). In fact, the positive emotional interactions in the learning environment is a crucial determinant in optimally structured self- and co-regulated learning (Westling et al., 2017). Also, student teachers' active and intentional self- and co-regulated learning is connected to positive affective atmosphere in the learning situation (Järvenoja & Järvelä, 2013). Thus, academic emotions and regulation of learning have a reciprocal relationship with each other (Pekrun & Linnenbrink-Garcia, 2012). For instance, the enjoyment of learning facilitates active SRL and the use of creative learning strategies, while the intentional and self-directed engagement in the task further strengthens the enjoyment experienced when learning (Pekrun & Linnenbrink-Garcia, 2012; Webster & Hadwin, 2015). This implies that as a cognitive mechanism, the regulation of learning mediates how emotions affect the learning (Pekrun et al., 2002).

1.4 STUDENT TEACHERS AS SELF- AND CO-REGULATING LEARNERS DURING TEACHER STUDIES

Prior research on student teachers' ability to regulate their own learning (SRL) (e.g., Endedijk et al., 2012; 2014; Heikkilä et al., 2012; Hwang & Vrongstinos, 2002) and the learning of others (CoRL) during their teacher education (e.g., Järvenoja & Järvelä, 2009; Järvenoja et al., 2017) have shown that 1) student teachers' self- and co-regulated learning skills cannot be taken for granted (e.g., Endedijk et al., 2012; 2014; Heikkilä, et al., 2012; Hwang & Vrongstinos, 2002), 2) student teachers need support in order to learn how to regulate their own learning and that of others (e.g., Kramarski & Michalsky, 2009; Perry et al., 2008; Tillema & Kremer-Hayon, 2002; Vrieling et al., 2010; 2012), and 3) teaching practicums provide a central arena practicing such skills (e.g., Endedijk et al., 2012; Perry et al., 2004; 2006; 2008).

First, student teachers' expertise in regulating their own or others' learning is not self-evident or easy (e.g., Heikkilä, et al., 2012; Hwang & Vrongstinos, 2002; Järvenoja & Järvelä, 2009). In fact, a recent study showed that up-to half of the first-year student teachers tended to avoid tasks and situations that challenged them to utilise SRL (Heikkilä et al., 2012). Also, variation in student teachers' abilities in SRL have been detected (Endedijk et al., 2012; 2014; Heikkilä et al., 2012; Hwang & Vrongstinos, 2002). For instance, student teachers use regulation strategies several ways: while some student teachers utilised prospective SRL such as preparatory strategies, others preferred retrospective strategies such as reflection (Endedijk et al., 2012; 2014). Yet those who utilised SRL tended to enjoy good academic performance and sense of professional growth (Kramarski & Michalsky, 2009; Hwang & Vrongstinos, 2002).

Also, the highly-demanding mode of socially regulated learning (SSRL) especially in terms of regulating emotions and motivation in collaborative learning tasks, is shown to be challenging for student teachers, and the degree of shared regulation is typically estimated differently by the group members (Järvenoja & Järvelä, 2009; Järvenoja et al., 2017). It has also been found that student teachers utilise different forms of regulation to maintain collaborative group work: some of the regulation processes within the group being genuinely shared, while others are regulated individually (Järvenoja & Järvelä, 2009). Moreover, a recent study showed that a minority of the student teachers' interactions during collaborative tasks included co-regulation or shared regulation of motivation and emotions (Järvenoja et al., 2017). In the previous literature, student teachers' regulated learning activities have been charecterised as being fragmented and spontaneous, and often lacking specific and consciously-set learning goals (Endedijk et al., 2012; Järvenoja et al., 2017). The previous findings thus imply that the student teachers' ability to engage in active SRL and CoRL cannot be taken for granted and that they need support in improving their regulation skills during the teacher education.

Secondly, student teachers' regulation skills can be developed and improved by explicitly teaching and modelling self- and co-regulation strategies (Hwang & Vrongstinos, 2002; Kramarski & Michalsky, 2009; Perry et al., 2004; 2006; 2008; Vrieling et al., 2012). Teacher educators are the enablers in building a learning environment that cultivates student teachers self- and co-regulated learning (Perry et al., 2008; Vrieling et al., 2012). Student teachers have been shown to benefit from the guidance of experienced and highly regulating teacher educators who actively and explicitly facilitate student teachers to adapt teaching strategies that supports pupils' SRL during teaching practicum (Perry et al., 2004; 2006; 2008). Particularly the active and synergic collaboration between student teacher, mentor teacher, and university teacher educator has been found to enhance student teachers' SRL skills during the practicums (Perry et al., 2006; 2008). Moreover, the complexity of tasks and practices that the mentor teachers adapted and designed at the practicum periods, were strong predictors of the opportunities student teachers had in developing and engaging their pupils' SRL in the classroom (Perry et al., 2006; 2008).

Also, peers have an impact on how student teachers can co-regulate pupils to regulate their learning in teaching practicums (Michalsky & Schechter, 2013). It has been shown that student teachers who co-regulated with peers by reflecting on their teaching experiences together during the practicum, were more capable in building a learning environment to support pupils' SRL than the student teachers who were supported only by teacher educators (Michalsky & Schecter, 2013). However, student teachers need guidance from teacher educators, in the form of support and modelling, in how to study and teach in a co-regulated manner with their fellow students (Perry et al., 2006;

2008). Teaching student teachers to regulate their learning requires the teaching of self- and co-regulation skills to be systematically and explicitly taught from the beginning of the teacher education (Randi, 2004; Vrieling et al., 2010; 2012).

Thirdly, previous research has shown that the authentic classroom environment in a teaching practicum tends to trigger student teachers to regulate their own and others' learning more actively and effectively compared to theoretical courses taught within the university (Endedijk et al., 2012; 2014). Various studies have underlined that teaching practicum is a crucial learning environment for student teachers and that the collaboration with mentor teachers and peers, the link between theory and practice, as well as the overall quality of practicums have positive effects on teacher learning (see e.g., Lawson, Çakmak, Gündüz, & Busher, 2015). The reason for deeper teacher learning and more active regulation might be that as teacher learning is a complex and personally meaningful process including the awareness of their own and pupils learning, it is best to advance it in authentic settings provided by the teaching practicums (Endedijk et al., 2012; 2014). Accordingly, during the teaching practicums student teachers both help pupils to become skilfully regulating learners and cultivate their own co-regulation abilities there. However, there have been only a few studies on student teachers' and pupils' regulated learning in classrooms and they have focused on student teachers facilitating pupils' self-regulated learning abilities, rather than CoRL between pupils and student teachers (e.g., Michalsky & Schechter, 2013; Perry et al., 2006; 2008). However, providing optimal support for CoRL activities in the classroom is a demanding task even for in-service teachers (Westling et al., 2017) and student teachers need guiding and real-life opportunities to practise regulation of themselves and others, and further, tools to utilise pupils' regulation attempts during lessons (McCaslin et al., 2014). High-level CoRL in classrooms requires teachers' efforts to prepare carefully and build an optimal space for active regulation, i.e., offering challenging tasks that promote pupils' autonomy in learning and giving opportunities for learning together in a warm and supportive classroom climate (McCaslin & Burross, 2011; Perry et al., 2002; Westling et al., 2017). There is evidence that primary schools teachers' co-regulating pupils' collaborative group work or sharing the regulation with pupils in the learning situations, is related to improvements in pupils' SRL skills, on-task behaviours during lessons as well as good learning outcomes **(**Grau & Whitebread, 2012; McCaslin et al., 2014; Westling et al., 2017).

1.5 TEACHER EDUCATION AS A LEARNING ENVIRONMENT FOR STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING

In teacher education, *the social interactions* with teacher educators, peers, and pupils provide the primary learning environment for active self- and co-regulation of learning. There is some evidence suggesting that especially CoRL is a key for student teachers to obtain both individual and social regulation skills (Perry et al., 2002; 2006; 2008). For example, those student teachers who regulated their learning during their teacher education or were able to enhance pupils' regulation possibilities in teaching practicums, recognised the others as a resource for learning and were able to utilise the informational support provided by teacher educators, peers, and pupils (Endedijk et al., 2012; Michalsky & Schechter, 2013; Perry et al., 2006; 2008). Student teachers' SRL and CoRL have been found to be particularly active in learning situations in which student teachers' regulation options have been intentionally and constructively supported on behalf of teacher educators (Michalsky & Schechter, 2013; Perry et al., 2002; 2006; 2008).

The previous findings thus imply that the dynamics between student teachers and their learning environment play a major role in the development of both SRL and CoRL skills among student teachers (Wolters, 2011). The *constructive friction* in the learning enviroment enables active SRL and CoRL during teacher education, while the *destructive friction* in the learning context harms regulated learning activities to be utilized (e.g., Hascher & Haganauer, 2016; Vermunt & Verloop, 1999). The latter (destructive friction) in teacher education refers to a dissonance between the student teacher and the learning environment, which can be caused by the student teacher having good SRL skills but being in a highly teacher-regulated learning environment, resulting in a decrease in motivation and causing negative academic emotions (Vermunt & Verloop, 1999). On the other hand, the constructive friction in terms of active SRL and CoRL is likely to occur if a teacher educators challenges and supports student teachers to adopt new ways of thinking and acting, which further promote a sense of autonomy and positive academic emotions (Vermunt & Verloop, 1999). Accordingly, it has been suggested that both SRL and CoRL can best be nurtured among student teachers in a learning environment in which student teachers' learning skills and learning objectives match, and they are challenged in a positive and supportive atmosphere, i.e., positive and balanced coherence occurring between student teachers and the social learning environment teacher education offers (Anttila et al., 2016; 2017; Inkinen et al., 2014; Järvenoja & Järvelä, 2013; Vermunt & Verloop, 1999). In turn, the mismatches between the student teachers' needs and the support provided, or even lack of it, causes negative academic emotions, reduces their well-being and hinders emotionally-optimal and active SRL and

CoRL activities to be adopted while learning to become a teacher (Anttila et al., 2016; 2017; Väisänen, Pietarinen, Pyhältö, Toom, & Soini, 2017).

Accordingly, optimal student teacher learning requires a learning environment in which their SRL and CoRL opportunities are supported for their own sakes, but also to benefit their future pupils' SRL and CoRL skills, i.e., student teachers should learn how to create a learning environment with constructive friction in terms of regulation of learning. Teaching practicums provide an arena for learning this (see e.g., Perry et al., 2004; 2006; 2008; Timoštšuk et al., 2016). Furthermore, a constructive and supportive atmosphere in teaching practicum improves both student teachers' and their pupils' opportunities to improve SRL and CoRL skills significantly (Perry et al., 2004; 2006; 2008). There is evidence that careful preparation, i.e., planning of lessons, as well as using constructivist pupil-oriented teaching methods, i.e., SRL and CoRL, reduce student teachers' emotionally negative experiences during teaching practicum, strengthen their learning about teaching, and affect positively in classroom atmosphere (Timoštšuk et al., 2016). A student teacher who learns how to support pupils' autonomy and participation, and a SRL and CoRL enhancing learning environment for pupils, supports the meaningfulness of learning in classroom, positive socioemotional learning climate as well as better learning outcomes (Hascher & Haganauer, 2016; Timoštšuk et al., 2016; Westling et al., 2017).

2. AIMS OF THE DOCTORAL DISSERTATION

The overall aim of this dissertation was gain a better understanding of Finnish primary school student teachers' skilful learning by exploring how they self- or co- regulate learning in the key learning experiences during their teacher education, both along the whole study path and during the teaching practicums. The following research questions were addressed:

1. How the student teachers self- and co-regulate their learning during their teacher education? (*Study I*)
2. What kinds of academic emotions are embedded in student teachers' self- and co-regulated learning activities during teacher studies? (*Study II*)
3. What characterises student teachers' and pupils co-regulated learning behaviours in classroom interaction during teaching practicums? (*Study III*)

The specific research questions were posed for the invidual studies (see also the original articles attached). *Study I* concentrated on analysing how Finnish primary school student teachers self- and co-regulate their learning during teacher studies, and in what learning activities. *Study II* focused more on analysing the academic emotions primary school student teachers experience in self- and co-regulated learning activities, how academic emotions are divided in different phases of self- and co-regulated learning, and what triggers academic emotions in self- and co-regulated learning activities. *Study III* took a more in-depth view in analysing student teachers' and pupils' co-regulated learning behaviours in authentic classroom interactions during teaching practicums by asking what characterises the learning situations in which the student teachers' and pupils' co-regulated learning behaviours are embedded in classroom interaction and how the student teachers and pupils co-regulate their behaviours in different phases of co-regulated learning.

The research questions were nested. This means that the research questions adressed in *Study II* were triggered by the findings from *Study I* suggesting that student teachers' self- and co-regulated learning incidents were emotional experiences, resulting exploration of emotions in SRL and CoRL in *Study II*. Moreover, the findings from *Studies I* & *II* indicated that teaching practicums were a highly significant learning enviroment for co-regulated learning resulting focusing on co-regualted learning behaviours in classroom interaction (*Study III*).

3. METHODS

In this doctoral dissertation it was utilized *qualitative multimethod design* to explore of how Finnish primary school student teachers self- and co-regulate their learning in the meaningful learning experiences along their study path (e.g., Brannen, 2005; 2008; Hesse-Biber & Leavy, 2006; Hesse-Bieber, Rodriguez, & Frost, 2016). In this dissertation qualitative multimethod design involved the idea in which qualitative analysis methods were enriched with quantification of the data (Brannen, 2005; 2008; Hesse-Biber & Leavy, 2006; Hesse-Biber et al., 2016; Maxwell, 2010; Sandelowski, 2001; Sandelowski, Voils, & Knafl, 2009). Accordingly, in addition to qualitative analysis methods, (i.e. abductive content analysis) quantification of the qualitatively constructed categories were adopted to clarify the actual emphasis of self- and co-regulated learning processes student teachers used during their teacher education (e.g., Brannen, 2008; Maxwell, 2010; Sandelowski, 2001; Sandelowski, et al., 2009). Quantification was carried out by calculating the frequency that the categories appeared in the data.

Furthermore, this dissertation relied on the *pragmatist view* in selecting the research methods utilised in the study, meaning that the selection of methods as a way to answer the research questions in the optimal way (Hesse-Biber & Leavy, 2006; Onwuegbuzie & Leech, 2005). Accordingly, analysis of both student teachers' interviews (i.e., their own perceptions about their learning), and the video data from a teaching practicum (i.e., their actual co-regulated behaviours) enhanced the understanding of the student teachers' self- and co-regulated learning activities throughout their studies. In addition, both the interview data and the video data focused on *the critical learning incidents* in teacher learning (Tripp, 2012). Critical incident refers to an event or situation which is significant and meaningful turning point or change on student teachers' life, for instance, in everyday classroom practice (Tripp 2012) and remembering and processing them enables student teachers to reflect on their own teacher learning in meaningful learning points during their teacher education (Tripp, 2012). Thus, the approaching of critical learning incidents student teachers experienced during their studies enabled profound focusing on their self- and co-regulated learning activities (*Study I*), emotions embedded in them (*Study II*) as well as actual co-regulated learning behaviours during authentic classroom interaction with pupils (*Study III*).

3.1 CONTEXT: FINNISH TEACHER EDUCATION AND TEACHING PRACTICUMS

In Finland, all primary school teachers must have a master's degree in educational sciences and they usually complete this programme in five years. Primary school teachers typically teach grades 1 to 6, when children are approximately 7 to 12 years old and teachers usually have their own class, for which they teach all school subjects in the curriculum. The teaching profession is highly appreciated and on average only 8% of primary school teacher applicants are accepted annually for teacher education programme at the University of Helsinki, where the data in this dissertation was collected (University of Helsinki, 2017). The primary school teacher degree comprises 300 ECTS (European Credit Transfer and Accumulation System) points. This comprises the main subject courses in either educational sciences or educational psychology (140 ECTS). The main subject courses include the pedagogical, psychological, and cultural bases of education (50 ECTS), research studies (70 ECTS, which includes courses in research methods and the bachelor's and master's thesis) and three mandatory teaching practice periods (20 ECTS). In addition, the teacher degree includes orientation and communication studies (25 ECTS), multidisciplinary studies in all subjects taught at primary school (grades 1–6) (60 credits), and minor and other complementary studies (75 credits). The minor subject studies are typically a larger study module in: a) one of the school subjects, b) pre-school and elementary education, or c) special education.

The three mandatory teaching practicum periods included in the teacher education are (1) the orientating practicum carried out at the start of the programme (3 ECTS), (2) the multidisciplinary practicum focusing on the pedagogies of the different subjects carried out during the middle of the studies (10 ECTS), and (3) an advanced practicum focusing of the entirety of teaching work carried out at the end of the teacher education programme (7 ECTS). Teaching practicum periods are organised at the teacher training schools affiliated with the Faculty of Educational Sciences at the University of Helsinki or in regular schools belonging to the field school network of the Faculty of Educational Sciences. The practicum periods are conducted with other student teachers. Accordingly, two or three student teachers are responsible for planning and conducting the lessons and evaluating the pupils. Student teachers invest carefully in planning the lessons. The lesson plan includes the roles and responsibilities of both the responsible student teacher and the assisting student teachers. The responsible student teacher is in charge of orchestrating the plan and being the leading teacher when it is her/his turn. The lesson plans are always discussed thoroughly with the actual classroom teacher, both before and after the lesson. Thus, teaching practicum periods are intensively supervised and organised.

Furthermore, during the last decade, the Finnish teacher education has become increasingly research-focused and today it is grounded on highly research-based teaching when it comes to content, pedagogical practices, and conducting research. Accordingly, student teachers are provided with opportunities to practise decision-making, justification and argumentation skills during their teacher studies (Krokfors, Kynäslahti, Stenberg, Toom, Maaranen, Jyrhämä, Byman, & Kansanen, 2011). The target time for completing a master's degree in primary teacher education is five years.

3.2 PARTICIPANTS

The data used in this dissertation were collected from two cohorts that represent Finnish primary school student teachers in different phases of their journey to becoming professional class teachers. The participants in both cohorts were studying at the University of Helsinki in the master's degree programme for primary school teachers. *Cohort I* contained participants who were primary school student teachers at the end of their teacher education programme, and *cohort II* entailed primary school student teachers attending teaching practicum periods at several stages of their studies.

Cohort I: the participants were 19 primary school student teachers who were studying their final years in the primary school teacher education programme. The participants included 14 females and 5 males, and their mean age was 31 years and varied from 23 to 51 years. They were selected for the interviews based on particular criteria: 1) their self-estimated time of graduation should be within one year, 2) they should be interested in working in a primary school after graduation, and 3) they had to be majoring in education, not in educational psychology (for more detailed description of the selection criteria for the interview see Ahonen, Pyhältö, Pietarinen, & Soini, 2015). Student teachers at the end of their studies were chosen because it enabled them to explore their self- and co-regulated experiences along the entire study path. Hence, choosing students at the end of their studies made it possible to ask them to recall and reflect on their studies and self- and co-regulated experiences from the beginning to the end. The data collected from primary school student teachers at the end of their teacher studies was used in Studies I and II.

Cohort II: the participants were 43 primary school student teachers who were in different phases of their studies conducting some of the teaching practicum periods relating to their teacher education. The participants included 33 females and 10 males and their mean age was 26 years and varied from 21 to 41 years. Eighteen of the student teachers (13 females, 5 males) were carrying out their orientating teaching practicum, 18 (14 females, 4 males) were carrying out their multidisciplinary teaching practicum, and 7 (6 females

and 1 male) were in their final practicum period (advanced practice). The sampling strategy enabled a comprehensive view on co-regulated behaviours displayed by the student teachers during the teaching practicum throughout the teacher studies to be built. The video data collected from primary school student teachers conducting their teaching practicum periods in different phases of their studies were used in Study III.

The distribution of females (cohort I: 74 %; cohort II: 77 %) and males (cohort I: 26%; cohort II: 23 %) was typical in the primary school student teacher population at the teacher education institute at the times when the data were collected for both cohorts (cohort I: 2011 and cohort II: 2014 and 2015). Also, the ages of the participants were representative as the ages of Finnish student teachers might vary a lot due to their different backgrounds before entering teacher education. Accordingly: some of the participants had entered the teacher education programme directly from upper secondary school without no previous experience of teaching, while others had previously worked as substitute teachers or had some other profession for years. In addition, some of the participants had been studying at the Open University before entering the teacher education programme and some of them had not previously undertaken teacher education.

The participants were informed about the study they had shown a willingness to participate in. Participation in the studies was voluntary and the participants did not receive compensation for participating and giving up their free time during the study. It was made clear to the participants that they could withdraw from the study any time and that their anonymity was carefully protected throughout the analysis processes and in publishing. Information about the participants has been presented in this dissertation to the extent it was possible to do so without jeopardising their anonymity. Furthermore, permissions for collecting the data was also obtained also from the teacher education institute.

3.3 MATERIALS

In this dissertation, *interviews* on student teachers' own learning experiences and *video data* from lessons held in teaching practicums were utilised to explore Finnish primary school student teachers' self- and co-regulated learning during teacher studies. The decision to analyse both self-reports and video data, enabled studying self- and co-regulated learning as personal experiences along study path and as overt behaviours during teaching practicums.

Interview data. Semi-structured interviews (e.g., Kvale, 1996; 2007) were utilised to capture student teachers' self- and co-regulated learning in the critical incidents during their teacher education *(Study I)* and in analysing the

academic emotions that were associated in self- and co-regulated activities (*Study II*). The interviews were conducted in 2011. In order to find participants in final stages of their studies, the researcher visited courses (particularly master's seminars) for student teachers at the end of their studies, briefly introduced the study to them and asked for volunteers to participate in the study. The interviews were semi-structured and all questions were posed for each participants. The interviews were recorded and transcribed verbatim by members of the research group or trained research assistants. The length of the interviews varied from approximately one to three and a half hours.

The interviews were conducted using a contextually modified version (Ahonen et al., 2015) of the Teachers' Professional Landscape Inventory (TPLI) (Soini, Pyhältö & Pietarinen, 2010) (See Appendix A). Four pilot interviews were conducted before collecting the data in order to test the validity of the adopted instrument. The interviews focused on three broad themes: 1) student teachers' critical learning incidents in teacher education, 2) perceptions about learning in teacher education and 3) perceptions about teachers' work at school (Ahonen et al., 2015). The interview included 16 questions about studying in the teacher education programme and also about a teacher's work at school. It also included four questions about the participants' personal and professional backgrounds (See Appendix 1). Furthermore, the retrospective narration (e.g., Connelly & Clandinin, 2006; Webster & Mertova, 2007; Xu & Connelly, 2010) and visualisation methods (e.g. Iantaffi, 2012; Kress & Leeuwen, 1990) were adopted in the interviews. During the interviews, participants were asked to memorize and mark up the learning incidents that had been important for their own learning during their study path in teacher education. In order to help the retrospective reminiscence of meaningful and emotionally loaded learning experiences, both positive and negative (Tripp, 2012), student teachers were asked to draw a visualisation of their study path when learning to become a teacher (Iantaffi, 2012; Kress & Leeuwen, 1990). The student teachers drew, for instance, maps, winding roads, and time-lines. The visualisation functioned as an aid for the participant to recall, explain, and reflect on both positive and inspiring as well as negative and challenging experiences that might otherwise have been difficult to verbalise (e.g., Angelides, 2001; Iantaffi, 2012; Kress & Leeuwen, 1990; Tripp, 1993; Woods, 1993). During the interview the researcher asked clarifying questions, such as, what happened in the critical learning incident, what the participant had learned in the situation, how they had felt in it and what made them change their way of thinking in that moment.

Video data. Video data were collected to capture the co-regulated learning behaviours in student teachers' and pupils' authentic classroom interaction (*Study III*). The data consisted of video-recorded lessons in the primary school, at which student teachers were conducting their teaching practicum periods in different phases of their studying. The video data were collected in

2013 and 2014. Explicit and precise information about the study was provided to all the participants, and their permissions was sought for videoing and using videos for research purposes in the data collecting situation, including student teachers, supervising teachers, pupils' parents, and schools (e.g. Derry et al., 2010). First, the study was introduced and agreed with supervising teachers at the practicum schools. After this, the permission from parents were requested. Finally, the study was introduced to the student teachers who were going to carry out their teaching practicum in these particular classrooms and their permissions were asked from them.

The data collection utilised *the procedure of guided reflection*, which is based on the critical incident procedure through which the meaningful learning experiences in the development of teaching profession are closely reflected (Husu, Toom, & Patrikainen, 2008). In the guided reflection protocol, the critical incidents are utilised in stimulating student teachers to reflect on their teaching and learning in the classroom (Husu et al., 2008). First the participants were asked to choose one lesson during teaching the practicum they wanted to be videoed. After the lesson was video recorded, the participants were given a copy of the film they could watch at home within a couple of days. The participants were instructed to choose two critical incidents from the videoed lesson that they found a) a positive and successful, and b) challenging, difficult or negative, in terms of their own learning (Tripp, 2012). In this study the videoed critical incidents were used to analyse student teachers' and pupils' co-regulated learning behaviours in authentic classroom interaction. The videos were wiewed to find the exact places and lengths of the critical incidents on the video, and both the behaviour and verbalisations in the critical incidents chosen by student teachers were transcribed verbatim. The length of the videoed incidents varied from couple of minutes to approximately 15 minutes

3.4 ANALYSES

In order to understand how Finnish primary school student teachers' self- and co-regulate their learning in critical learning incidents experienced during their teacher education the qualitative content analysis (e.g., Bengtsson 2016; Drisco & Maschi, 2015; Elo & Kyngäs, 2007; Patton, 1990) with abductive analysis strategy was utilized in all part-studies (e.g., Chamberlain, 2006; Coffey & Atkinson, 1996; Haig, 2005; Levin-Rozalis, 2004; Morgan, 2007; Timmermans & Tavory, 2011). Abductive strategy allows theory-driven (deductive) and data-oriented (inductive) approaches to be combined in the analysis. Thus, in this dissertation it was possible to consider the personal insights and experiences of the student teachers and interpretations made from their behavior. Abductive analysis included *inductive* approach in

describing the special features of the data, and *deductive* approach, as analysis procedures in the studies also leaned on previous research on self- and co-regulated learning and academic emotions (e.g., Timmermans & Tavory, 2011). In other words, my interest in this qualitatively-driven dissertation was to investigate how student teachers perceive what they have done and how they have felt when learning has been self- or co-regulated, but also what they actually do while co-regulating in authentic teacher learning environment, i.e., in teaching practicum.

3.4.1 ANALYSIS ON STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING ACTIVITIES DURING TECAHER STUDIES

The interview data in *Study I* were qualitatively content analysed by applying an abductive strategy, i.e., utilising both inductive and deductive analysis protocols (e.g., Bengtsson, 2008; Chamberlain, 2006; Coffey & Atkinson, 1996; Elo & Kyngäs, 2007; Haig, 2005; Levin-Rozalis, 2004; Morgan, 2007; Timmermans & Tavory, 2012). Student teachers' self-and co-regulated learning incidents and their differences were analysed in four complementary phases (I, II, III, & IV).

I) All critical learning incidents including self- or co-regulated learning were coded into the same category using a deductive strategy (Coffey & Atkinson, 1996; Mayring, 2000) drawing on both critical incidents and the SRL literature (Puustinen & Pulkkinen, 2001; Tripp, 2012; Zimmerman, 2002). The criteria for student teachers' critical learning incidents involving regulation of learning were that a change had occurred in the student teacher's thinking and/or skills (positive, increased learning; or negative, decreased learning), and that the change was perceived as significant and personally meaningful (Tripp, 2012), and further that it included elements of regulated learning, i.e. goal setting, planning, monitoring, controlling, strategy use and/or reflection (Puustinen & Pulkkinen, 2001).

II) All the critical learning incidents including regulated learning were coded into three exclusive categories using an inductive strategy: positive, negative, and ambivalent, based on reported quality and emotional tone of the experience.

III) All the critical learning incidents entailing regulation of learning were coded into two exclusive main categories in more detailed manner making a clear distinction between self- and co-regulated learning by applying a deductive strategy:
    a. The text segments entailing primary self-regulated activities including personal (a) *preparatory* (task analysis, planning, or

goal setting) and/or (b) performance (monitoring, controlling or strategy use), and/or (c) appraisal (regulated reflection on learning. i.e., reflection on previous regulative phases or how to improve performance in the future, were coded into the same category.

b. Then, text segments entailing co-regulated activities characterized by students' (a) preparatory (joint task analysis, planning or goal setting) and/or (b) performance (joint monitoring, controlling or strategy use), and/or (c) appraisal (regulated reflection on learning together) were coded into the same category.

Episodes were coded as self- or co-regulated, if either task analysis, planning and/or goal setting, *or* monitoring, controlling and/or strategy use was reported, *or* reflection combined with the previous regulation phases was described. Mere mention of co-work or influence of other students was not enough to fulfill the criteria of co-regulated learning and before a text segment was coded as co-regulated, above mentioned criterion of regulated learning ought to be fulfilled. This phase involved 85 self- (f=53) and co-regulated (f=32) critical learning incidents.

IV) In fourth and final analysis phase an inductive strategy was applied to determine how learning incidents including self- or co-regulated learning activities differed from each others.

The categories resulting from the content analysis were validated by the research group at the end of each phase of analysis (Miles & Huberman, 1994). An independent parallel analysis of 30% of the data was carried out. Interrater reliability measured with Cohen's kappa (κ) in regard to the self- or co-regulated learning was 1.0, indicating complete agreement, and in regard to the phases of regulated learning, Cohen's kappa (κ) was 0.74, indicating adequate agreement.

3.4.2 ANALYSIS ON THE EMOTIONAL LANDSCAPE ON STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING ACTIVITIES

In the second study, the analysis concerning student teachers' self- and co-regulated learning activities were combined with the analysis of student teachers' academic emotions analysed from the same data (Anttila et al., 2016). The aim was to explore the emotional spectrum in student teachers' self- and co-regulated learning as well as the triggers of emotions experienced in self- or co-regulated learning activities. Hence, the analysis in *Study II* included three independent analyses: (1) student teachers' self- and co-

regulated learning activities (see III above) and (2) student teachers' academic emotions (see V below), which were combined to look more closely on (3) the specific academic emotions and their triggers in student-teachers' self- and co-regulated learning activities (VI & VII).

V) In the second independent analysis phase all the text segments in which the student teachers described emotional experiences during their study path were identified using a deductive strategy (Anttila et al., 2016). Drawing on valence-arousal theory (Pekrun, 2006) the emotional experiences were coded based on the valence of the experience (positive and negative emotions) and of the arousal, i.e., the intensity of the physiological emotional reaction to the experience (activating, neutral or deactivating) (Feldman Barrett & Russell, 1998; Linnenbrink, 2007).
   a. The analysis resulted in two basic categories based on the valence of the emotion: (a) positive emotions, such as entusiasm and enjoyment; and (b) negative emotions, such as anxiety and exhaustion. (See the original study Anttila et al., 2016 for all the academic emotions found.)
   b. The arousals of the emotional experiences were categorized into three groups: (a) activating, (b) neutral, and (c) deactivating.

   An independent parallel analysis of 20% of the data was carried out and the inter-rater agreement was 92% (Anttila et al., 2016). Due to the three-dimensional nature of the student teachers' academic emotions analysis (i.e., the extensive number of identified emotions, the positive and negative valence of emotions and arousals of the emotional experiences) the inter-rater reliability was analysed by calculating the percentage of agreement that is directly interpretable (e.g., McHugh, 2012).

VI) To find out what academic emotions were embedded in student teachers' self- and co-regulated learning activities, the first (self- and co-regulated learning activities) and the second (academic emotions) independent analyses were combined resulting in the emotions expereince being embedded in the different phases of student teachers' self- and co-regulated learning, i.e., in preparatory, performance, or appraisal. The academic emotions found in student teachers' self- or co-regulated learning activities were in terms of positive emotions *adequacy, enthusiasm, enjoyment, interest, admiration, surprise, satisfaction, belonging, amusement,* and *longing*; and in terms of negative emotions *irritation, anxiety, fear, exhaustion, disappointment,* and *inadequacy*.

VII) Finally, the triggers of emotional experiences embedded in the self- and co-regulated learning activities were categorised in-to three groups accoring to the focus of the triggers, by applying an inductive strategy. This analysis resulted in three categories: (a) facing challenges, (b) social support, and (c) innovative learning and knowledge construction.

The categories resulting from the final phase of the analysis were validated by the research group (Miles & Huberman, 1994).

3.4.3 ANALYSIS ON STUDENT TEACHERS' AND PUPILS' CO-REGULATED LEARNING BEHAVIORS IN AUTHENTIC CLASSROOM INTERACTION

An abductive content analysis and a critical incidents protocol were applied in *Study III* in which the aim was to use video data to analyse student teachers' and pupils' co-regulated learning behaviours during an authentic classroom interaction. Hence, to analysis ended only the critical incidents chosen by the student teachers themselves, i.e., events they considered successful or challenging in terms of their teacher learning. The abductive analysis included both inductive and deductive approaches to the data. Inductive analysis was used when analysing what characterised the learning situations and the general atmosphere in the classroom in which student teachers' and pupils' co-regulated learning behaviours were embedded. A deductive content analysis strategy utilising previous studies on teachers' critical learning incidents in teaching (Tripp, 2012) and socially-regulated learning in classrooms was applied in the analysis of co-regulated learning phases (e.g., Grau & Whitebread, 2012; Kistner et al., 2010: Rogat & Linnenbrink-Garcia, 2011). Accordingly, in terms of co-regulation phases, the video data were analysed based on systematic sampling to examine the specific and theoretically grounded research questions (e.g., Derry et al., 2010). The video analysis included three complementary phases:

I) First all the critical incidents identified by student teachers were extracted from the video recordings, i.e., the situations that the student teachers had found to be positive, meaningful and successful, or challenging, difficult and negative in terms of their teacher learning (Tripp, 2012). The length of the incidents varied from approximately two minutes to 15 minutes. At this stage, student teachers' and pupils' verbal interaction and non-verbal macro-level behaviour during the critical learning incident were analysed. All non-verbal macro-level behaviour was transcribed as

descriptions of what was happening in macro-level behaviours, and all verbal interaction that it was possible to transcribe in each videoed critical incident was transcribed verbatim in to the same text file. Only those transcriptions, in which verbal interaction was possible to transcribe were chosen for the analysis. Hence, 32 positive incidents, 28 negative incidents and three ambivalent incidents were marked for deeper analysis to find out what co-regulated behaviours they might include.

II) In the second analysis phase, the transcriptions were categorised according to the time they appeared in the lesson as well as describing the overall atmosphere in the classroom at those moments. A typical lesson lasts from 45 to 70 minutes (longer when it was a double lesson) and was divided into three segments: the beginning of the lesson (the first 10-15 minutes, when often a new subject or the learning task was introduced), the middle (from about 10 minutes to even 60 minutes, when the subject was covered or the learning task conducted), and the end (the last 10 or 15 minutes, when the learning task had to be finished or homework assigned).

III) In the third analysis phase the specific transcriptions of the critical classroom situations including student teachers' and pupils' verbal and non-verbal interaction and behaviour during the critical incidents were more closely analysed. Furthermore, the incidents which were found to entail co-regulated learning behaviours were coded into the three categories based on the quality of behaviours displayed. The student teachers' and pupils' co-regulated learning was interpreted from a synthesis of both the verbal interaction and non-verbal behaviour (see also Grau & Whitebread, 2012; Rogat & Linnenbrink-Garcia, 2011). The student teachers' and pupils' co-regulated learning behaviours were coded in to three categories a) *co-preparatory*, b) *co-performance*, and 3) *co-appraisal*. The specific criteria utilised in the analysis were as follows:

a) *Co-preparatory* entailing verbalisation and behaviours of: forethought and activation (i.e., activating pupils' previous knowledge, for instance by posing activating questions about the subject of the lesson), task-analysis (i.e., analysing the task at hand: what it is about, what needs to be done), goal setting (i.e., setting goals for the learning task), and/or planning (i.e., planning how to proceed with the task, what learning strategies to use in the task and how to deal with the possible challenges faced during the task) in collaboration with pupils or with other student teacher(s).

b) *Co-performance* use comprising verbalisation and behaviours connected to: monitoring the learning situation (i.e., active

checking of the learning situation and instant responding when a change needs to be done), control (i.e., controlling one's own or pupils' behavioural or cognitive actions and changing learning or disciplinary strategies when needed), and/or applying strategies (i.e., activating pupils to participate during on-task phase and use of different learning or disciplinary strategies to support others' learning), together with pupils or with other student teacher(s).

c) *Co-appraisal* consisting of verbalisation and behaviours connected to: reflecting on the learning situation (i.e., rewieving what has just been done, evaluation of appropriation of the goals set for the task, evaluation of the behavior connected to learning, giving feedback on the task, comparing learned knowledge to own experiences in terms of the learned subject, and/or evaluation of the possibilities to apply the knowledge gained in the future) together with pupils or with other student teacher(s).

Twenty-five per cent of the data, i.e., randomly selected 11 student teachers' critical learning incidents that went for deeper analysis and which includeds co-regulated learning behaviours was coded by another member of the research group. The inter-rater agreement in terms of the regulated learning phases was 92%. In the few cases of disagreement, consensus on the final categorisation of the phase of co-regulated learning behaviour was reached through discussion among the researchers.

3.5 SUMMARY OF THE METHODS

The aim of this dissertation is to understand how Finnish primary school student teachers' self- and co-regulate their learning by utilising a qualitative multimethod procedure (e.g., Brannen, 2005; 2008; Hesse-Biber & Leavy, 2006; Hesse-Bieber et al., 2016). Thus, this doctoral study was conducted by collecting data through semi-structured interviews and video recordings and analysing the data with qualitative content analysis (e.g., Bengtsson 2016; Drisco & Maschi, 2015; Elo & Kyngäs, 2007; Patton, 1990) enriched with quantification of the data (Maxwell, 2010; Sandelowski, 2001; Sandelowki et al., 2009). In Table 1, the research aims, participants, methods, instruments, and procedures used in *Studies I*, *II* and *III* are presented.

Table 1. *Overview of the study methods and procedures*

Study	General aim	RQ	Participants	Method	Instrument	Analysis
Study I	Explore student teachers' self- and co-regulated learning activities during their studies.	1	Cohort 1: 19 Finnish primary school student teachers at the end of their studies 74% Female, 26% Male Mean age (min/max): 31 (23/51)	-Semi-structured interview	Critical learning incidents	Qualitative, abductive content analysis, quantification of the qualitative data
Study II	Explore the spectrum of academic emotions experienced in student teachers' self- and co-regulated learning activities.	2	Cohort 1: 19 Finnish primary school student teachers at the end of their studies 74% Female, 26 % Male Mean age (min/max): 31 (23/51)	Semi-structured interview	Critical learning incidents	Qualitative, abductive content analysis, quantification of the qualitative data
Study III	Explore student teachers' and pupils' co-regulated learning behaviours in authentic classroom interaction during teaching practicum.	3	Cohort 2: 43 student teachers attending a teaching practicum in different phases of their studies. 42% in orienting teaching practicum, 42% in multidisciplinary teaching practicum, 16% in final practicum 77% Female, 23 % Male Mean age (min/max): 26 (21/41)	Video-recorded lessons	Critical learning incidents	Qualitative, abductive content analysis, quantification of the qualitative data

4. RESULTS

Next the key results from the three studies are presented following the research questions, starting from student teachers' self- and co-regulated learning activities during teacher studies, the academic emotions embedded in them, and finally looking closely at student teachers' and pupils' co-regulated learning behaviours in authentic classroom interaction. The results are reported in more detail in the original journal articles in which also the extracts from the authentic interview citations (*Studies I* and *II*) and classroom interaction (*Study III*) can be found.

4.1 SELF- AND CO-REGULATED LEARNING ACTIVITIES DURING TEACHER STUDIES

Student teachers reported 85 critical learning incidents entailing self- or co-regulated learning activities. Results further revealed that student teachers described self-regulated learning activities (62 % of the learning incidents entailing regulation of learning) more often than co-regulated learning activities (38 % of the learning incidents entailing regulation of learning). Self-regulated learning (SRL) activities entailed student teachers' descriptions of individually-regulated learning and included task analysis, planning and setting goals for learning, monitoring, controlling and use of learning strategies and reflection of learning. Co-regulated learning (CoRL) entailed such activities being carried out jointly with peers, teacher educators, or pupils. On average one student teacher described five incidents in which self- or co-regulated learning took place.

Accordingly, student teachers' reported self- and co-regulated learning activities entailed the same phases included in regulated learning (i.e., *preparatory*, *performance*, and *appraisal*). The emphasis of each phase was similar both between and within different forms of regulated learning (see Figure 2). Thus, phases of regulated learning were often patterned. Typically one critical learning incident included various elements of regulation activities and student teachers for example, set goals for their learning, analysed the task, monitored, applied learning strategies, and reflected on the whole learning experience.

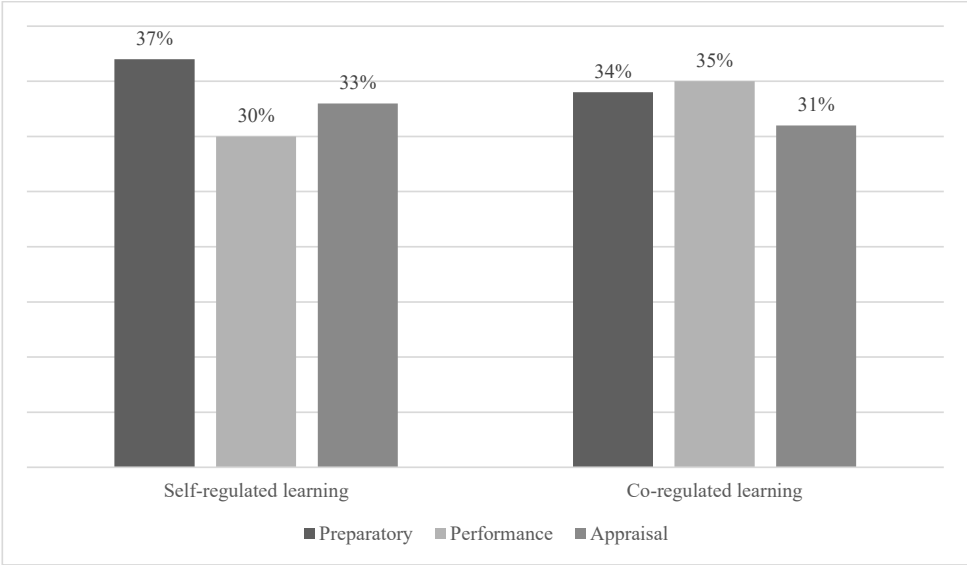

Figure 2. *Regulation phases in student teachers' self- and co-regulated learning*

In terms of *preparatory* SRL activities (task analysis, planning, and goal setting) student teachers' reported, for instance, analysing the different aspects and requirements set for learning task, planning how to proceed with the course or whole semester and setting goals for short- and long-time learning tasks. Typically student teachers described making plans for how to read for exams and analysing the course requirements and their own abilities to fulfil them. For instance, they described making schedules for studying and considered what would be appropriate learning methods for mastering learning tasks they perceived challenging for themselves. In terms of CoRL activities student teachers typically described careful preparation of lesson plans with peers. Student teachers also reported making comparisons between their own teaching and their peers' lessons, which affected their mutual goal setting and teaching methods during teaching practicums. Co-regulated preparatory activities were characterized by a high investment (e.g., in terms of the used hours) in planning lessons, analysing pupils' opportunities for successful learning and high goals set for succeeding in shared teaching.

In terms of *performance* (monitoring, control, and strategy use) student teachers reported SRL activities, such as, developing their academic writing skills and methodological knowledge during the thesis process. Student teachers also reported active monitoring and controlling of their performance in the classroom and applied self-regulated learning strategies in the teaching practicum, for instance, by revising their lesson plans for the next lesson if they had noticed that a plan was not appropriate. It was also typical for student teacher to report ambivalent feelings regarding their own capabilities to succeed at the task at hand (e.g., theses), but after overcoming the challenge

by using effective learning strategies, they had even experienced a sense of flow when completing the task. Co-regulated monitoring, control, and strategy use student teachers applied regularly during teaching practicum or in group work in which theoretical knowledge had to be integrated in to practice. For instance, student teachers reported how they had first together carefully prepared and then, during the course or practicum, highly invested in implementing a special course (e.g., in history) for particular school class. During these situations student teachers described themselves as being highly active in monitoring the appropriateness of the lesson plans and their teaching practices, and changed them together accordingly if needed. While becoming more proficient in their teacher education study, it became easier for them to monitor their own and their peers' teaching and classroom interaction, and further, control them together in a meaningful way. This was reflected in the reported use of more diverse teaching strategies with peers than at the beginning of teacher education. Moreover, common for both self- and co-regulated strategy use was that student teachers displayed more devoted monitoring and controlling learning as well as diverse learning strategies in cases where they had found the course and course exam to be challenging or inspiring.

In terms of *appraisal* (i.e., reflection) in SRL, student teachers typically reflected the practical aspects of studying and the choices they had made, for example, in terms of the thesis topic, study habits during the thesis seminar or another course, although some student teachers were also able to reflect analytically when they considered the options for applying the skills gained during teacher education. However, this type of highly analytical reflection was more typical in student teachers' CoRL activities. Co-reflection was particularly typical in teaching practicums with peers and in courses in which a demanding, but at the same time encouraging, teacher educator had set high goals for student teachers' learning throughout the course and encouraged students engage to high-quality planning, attentive monitoring of learning, use of diverse strategies, and deep reflection afterwards. Teaching practicum experiences prompted student teachers to reflect on their performance and their knowledge and skills as teachers individually, but especially with peers and practice supervisors. Moreover, student teachers often reflected on the importance of utilising theories related to teaching, learning and instruction understood during their theoretical university courses especially when they had been sharing the learning process with peers, for instance, in teaching practicums.

4.1.1 TYPICAL CONTEXTS FOR ACTIVE SRL AND CORL

The results also showed that there were particular courses and learning contexts in which student teachers reported mainly SRL activities. Theses seminars were especially the context for active SRL. In addition, SRL activities were emphasized in major subject courses in which theoretical aspects need to be reflected towards personal practical experiences. Student teachers also reported SRL activities during teaching practicums, although teaching practicum provided an arena especially for student teachers' CoRL activities.

CoRL typically occurred in formal learning situations such as in the major courses in which theory and practice need to be combined and which included collaborative learning opportunities. Student teachers also reported CoRL in informal activities such as in situations in which student teachers helped each other to plan the courses or study for exams. However, *teaching practicum* including the pre-planning with peers acted as the most important arena for various modes of CoRL activities. In teaching practicums, student teachers reported that they might have doubted their own abilities as a teacher but that teacher educators or peers support and encouragement to test one's own skills and limits in teaching methods triggered innovative and active CoRL with peers. Sometimes student teachers faced challenges during teaching practicum such as with inadequate lesson plans and pupils' behaviour, which launched co-regulated monitoring and reflection with peer students to improve the situation to the next lesson. Common for the situations in teaching practicum as well as other courses combining theory and practice, was that student teachers were constructingly challenged to engage with new learning by a teacher educator or by peer, but still felt autonomous in terms of their learning, which offered opportunities to regulate one's own and others' learning in many ways.

4.1.2 DIFFERENCES IN SELF- AND CO-REGULATED LEARNING ACTIVITIES

Further investigation revealed that self- and co-regulated learning differed in terms of the regulation activities that were applied. Although SRL activities were present in more diverse contexts in teacher education, they were overall typically simpler and more task-related compared to CoRL activities which reached deeper levels in active and new-constructing teacher learning. To be more precise, in terms of SRL, student teachers typically applied it in specific and relatively simple learning tasks with more tangible goal setting and strategy use, such as when preparing for exams, making timetables for thesis work, or choosing practical strategies for conducting particular learning tasks.

Student teachers' self-regulated strategies were usually task oriented, conformative, and less varied than in co-regulated activities. In addition, reflection during SRL incidents was typically more incidental and outcome-oriented, i.e., reflection on learning, e.g., reflection on benefits of well-made bachelors' thesis, or reflection of chosen reading habits for a particular exam.

In terms of CoRL, student teachers' learning activities usually entailed more active utilising of regulated learning phases compared with applying SRL activities. More specifically, co-regulated task analysis, goal setting, and planning were typically applied when student teachers faced complex and highly challenging problems at the beginning of teaching practicum or in group works in courses in which demands for learning were quite high and they were challenged positively from the beginning. Furthermore, the co-regulated strategies student teachers applied were typically transformative and application-oriented. Student teachers typically actively monitored and applied co-regulated strategies when they faced a new kind of situation (e.g., challenging or respectively positively rousing) and were expected to apply theoretical and practical knowledge and transform it into pedagogical knowledge that would benefit them as future teachers. The student teachers also reflected on their learning together more critically than when self-regulating, and descriptions of co-regulated reflection often entailed more systematic, proactive, and critical reflection. Moreover, reflection for new learning in terms of the student teachers' future work as primary school teachers characterized the reflection on jointly regulated learning tasks.

Finally, in CoRL activities more typically there appeared a constructive friction in the learning situation triggering student teachers' co-regulated activities to deeper level in terms of teacher learning and making them highly positive and meaningful learning experiences. In CoRL activities, a constructive friction was noted between student teachers' current skills and the requirements that either teacher educator had set for them or between peer having different kinds of expertise in terms of teaching. In other words, dynamics between the student teachers' and their learning environment that provided a coherent match in the form of the emotional support and challenge, offered student teachers opportunities for high quality CoRL and gave them valuable experiences of their own resources as teachers. Furthermore, being successful in tasks supported by peer(s) or the teacher educator, and feelings that one was truly learning and constructing new knowledge and practical teaching skills together for one's future profession, that is to say, experiencing the development of professional agency, triggered active CoRL practices which further triggered positive activating emotions during the meaningful learning incidents. See the summary of the differences between self- and co-regulated learning activities in Table 2.

Table 2. *The differences between self- and co-regulated learning*

Phases of regulated learning	Self-regulated learning	Co-regulated learning
Preparatory (task analysis, planning & goal setting)	Specific Tangible Simple	Holistic Highly challenging Complex
Performance (monitoring, control & strategy use)	Conformative Task oriented Less variation	Active, transformative Application oriented Varying
Appraisal (reflection of learning)	Incidental Task focused Outcome oriented Reflection *on* learning	Systematic Critical Relational Reflection *for new* learning

Table 3. *The summary of key results in Study I*

- ➔ Student teachers applied SRL more often than CoRL
- ➔ The regulated learning phases were balanced within and between SRL and CoRL
- ➔ Active SRL was emphasised in courses calling for individual responsibility in learning, e.g., in Thesis seminars
- ➔ CoRL was emphasised especially in teaching practicum and in courses where teacher educators had set high demands for teacher learning
- ➔ Although CoRL activities were not reported as often as SRL activities, were they overall perceived as highly significant and instructive in terms of teacher learning
- ➔ CoRL activities reached deeper levels in active and new-constructing teacher learning than SRL activities

4.2 THE ACADEMIC EMOTIONS IN STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING ACTIVITIES

Results of *Study I* showed that student teachers' self- and co-regulated learning activities were typically embedded in the overall positively toned critical learning incidents experienced during teacher education. The clear majority of the incidents including self- or co-regulated learning were perceived as positive emotional experiences (88 %) and were thus characterised by successful learning individually or with others as well as being a positively-toned atmosphere for the situation. However, student teachers also reported self- or co-regulated learning in few ambivalent (7 %) and overall negative (5 %) critical learning incidents (see Table 4 below). A difference between reported regulated learning and ambivalent and negative experiences was found. In ambivalent experiences, entailing mixed feelings i.e., both negative and positive emotions, student teachers reported only SRL

activities. Characteristic of the ambivalent incidents was that student teacher experienced difficulties which turned in to meaningful and active learning during the incident. The few negative learning incidents in which student teachers reported only negative emotions were CoRL situations. Characteristics of these included, for instance, disappointment experienced in teaching practicums or a sense of dissonance between one's own high investments and teacher educators' harsh criticism.

Table 4. *The emotional tone in student teacher' self- and co-regulated learning incidents*

	Positive	Negative	Ambivalent	Total
Self-regulated	*f*= 47	-	*f*= 6	*f*=53 62%
Co-regulated	*f*= 28	*f*= 4	-	*f*=32 38%
Total	*f*= 75 88%	*f*= 4 5%	*f*= 6 7%	*f*=85 100%

The further investigations in *Study II* showed that student teachers reported primarily positive emotions (80%), especially positive activating emotions, in both self- and co-regulated learning activities, most typically enthusiasm, enjoyment and interest. Negative emotions (20%) were less frequently described in student teachers' self- and co-regulated learning activities. The reported emotions were distributed evenly between self- (53%) and co-regulated (47%) learning activities. However, as CoRL incidents (*f*=32) were reported less often than SRL (*f*=53), this indicates that CoRL incidents were highly emotional experiences. Furthermore, the number of reported academic emotions during regulated learning experiences ranged from one to four emotions. Typical also was that the same emotion, for instance the most frequently reported emotion enthusiasm, was reported during at least two regulated learning phases.

4.2.1 SPECIFIC ACADEMIC EMOTIONS IN STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING ACTIVITIES

The majority of the academic emotions that the student teachers reported were positive activating (73.4%) both in self- (*f*=49) and co-regulated (*f*=42) learning activities. Most frequently student teachers reported enthusiasm in all phases of self- (*f*=31) and co-regulated (*f*=21) learning. Typical for the self- and co-regulated learning incidents in which enthusiasm was described was that the student teachers were dealing with learning tasks that triggered them to reflect on their future work as teachers or in teaching practice when planning, conducting and reflecting lessons with peers. However, there were some slight differences in the reported positive activating emotions between

self- and co-regulated learning. For instance, interest was reported more often in self- (*f*=10) than co-regulated learning (*f*=3) activities, while enjoyment was more typically reported in co-regulated (*f*=12) than self-regulated (*f*=6) learning activities. Student teachers reported positive neutral emotions, such as satisfaction or belonging i.e., feeling of togetherness during teaching practicum periods with close peer students, rarely in self- (*f*=4) and co-regulated (*f*=3) learning activities. Negative emotions were also reported quite rarely in self- and co-regulated learning incidents, but in fact negative deactivating emotions, such as exhaustion (in self- *f*=8 and co-regulation *f*=8) were reported slightly more frequently than negative activating emotions such as anxiety (in self- *f*=5 and co-regulation *f*=4). Negative emotions embedded in SRL were typically related to anxiety in terms of bachelor's or master's theses, or exhaustion caused by the teaching practicum. However, these typically shifted into positive emotions after a difficult start. In CoRL, negative emotions emerged for instance in situations in which student teachers had invested heavily in planning and implementing lessons, but received negative and in their opinion unfair feedback from the teacher educator on their performance. Emotions associated with self- and co-regulated learning activities are presented in Table 5.

Table 5. *Valence and arousal of the academic emotions in student teachers' self- and co-regulated learning*

Valence and arousal of emotions	Self-regulated learning	Co-regulated learning	Total
Positive activating	*f*=49	*f*=42	*f*=91
e.g. enthusiasm, enjoyment, admiration	39.5%	34%	73.4%
Positive neutral	*f*=4	*f*=3	*f*=7
e.g. satisfaction, belonging	3%	2.4%	5.6%
Positive deactivating	-	*f*=1	*f*=1
longing		0.8%	0.8%
Negative activating	*f*=5	*f*=4	*f*=9
e.g. anxiety, irritation	4%	3%	7.3%
Negative deactivating	*f*=8	*f*=8	*f*=16
e.g. exhaustion, disappointment	6.5%	6.5%	12.9%
Total	*f*=66	*f*=58	*f*=124
	53%	47%	100%

The results also revealed that in student teachers' SRL activities emotions were distributed almost evenly between regulatory phases, while in CoRL the student teachers reported a variety of emotions slightly more frequently during the reflection phase (See Table 6 below). Furthermore, positive activating emotions were emphasised in all regulated learning phases both in self- and co-regulated learning activities. In student teachers' SRL activities positive activating emotions were distributed quite equally throughout all phases of regulated learning. In CoRL on the other hand, positive and activating emotions were reported most often during joint strategy use and monitoring as well as in reflection on learning. In terms of other than positive activating emotions the differences between self- and co-regulation and the regulation phases were very small. Valence and arousal of reported emotions in the different phases of self- and co-regulated learning activities are shown in Table 6.

Table 6. *The valence and arousal of reported emotions in the different phases of self- and co-regulated learning*

Phases of regulated learning	Arousal of the emotion	SRL Positive (f)	SRL Negative (f)	CoRL Positive (f)	CoRL Negative (f)
Preparatory (task analysis, planning & goal setting)	Activating	18	4	10	2
	Neutral	1	-	-	-
	Deactivating	-	1	-	4
Performance, (monitoring, control & strategy use)	Activating	14	1	16	1
	Neutral	1	-	-	-
	Deactivating	-	4	-	2
Appraisal (reflection of learning)	Activating	17	-	16	2
	Neutral	2	-	3	-
	Deactivating	-	3	1	1

4.2.2 THE TRIGGERS OF ACADEMIC EMOTIONS IN STUDENT TEACHERS' SELF- AND CO-REGULATED LEARNING ACTIVITIES

Further investigation revealed, that there were certain elements in teacher education that offered good starting points on active and emotionally positive self- and co-regulated learning. However, there was a difference in teacher learning whether it had happened largely alone or with others, i.e., with peers, teacher educators or pupils. Furthermore, three major factors (facing challenges, social support, and innovative learning and knowledge construction) were found in active self- and co-regulated learning triggering academic emotions, but in CoRL these factors affected teacher learning in a more synergic and profound level. To be more precise, these three factors triggering mainly positive and activating emotions in self- and co-regulated learning among student teachers were typically strongly intertwined in CoRL activities, whereas in SRL activities one dimension (typically facing challenges or innovative learning and knowledge construction) was emphasized.

Student teachers' reported academic emotions in self- and co-regulated learning activities when (1) *facing challenges* during teacher education. In fact, the challenging situations were also the ones in which the rarely reported negative academic emotions occurred. In terms of SRL activities typical was that the doubts about personal abilities in study tasks or finding a study task to be unattractive triggered negative emotions, such as anxiety. However, the

emotion in these situations typically shifted towards positive because of one's efforts, such as careful planning and getting familiar with the study material, which further triggered positive activating emotions. Sometimes, negative emotions, such as feelings of inadequacy emerged despite student teachers having reported active SRL, for instance when writing bachelor's and master's theses that progressed slowly although the student had invested strongly in it. In terms of CoRL, student teachers reported facing challenges like feelings of inadequacy or exhaustion at the beginning of teaching practice, when they realised that lesson plans were ineffective. However, challenges faced together typically strengthened co-regulated activities together along the teaching practice, which further helped them to solve problems in their lesson plans, resulting in enthusiasm and enjoyment.

In addition to facing challenges, (2) *social support* from peers or teacher educators, rarely in the self-regulated but, especially, in co-regulated learning incidents often triggered academic emotions among student teachers. Co-planning and implementing lessons during the teaching practicum with more capable or skilful peers, triggered long-lasting enthusiasm or enjoyment throughout the learning incidents. Accordingly, support and encouragement from peers inspired students to try new teaching methods, and challenged novice teachers to outdo themselves. This further contributed to feelings of enthusiasm and enjoyment stemming from the successful experiences. Support and demands provided by teacher educators also played a central role in triggering positive activating emotions, such as enthusiasm and admiration. The few negative emotions reported in CoRL incidents typically involved teacher educators' negative or critical feedback, or a lack of support from them. The shared feeling of not receiving adequate support from teacher educators or being unfairly criticised despite of carefully invested lesson plans in some incidents triggered long lasting negative emotions, but on the other hand encouraged reliance on the peer in the challenging situation.

Also (3) *innovative learning and knowledge construction* triggered mainly positive and activating emotions both in self- and co-regulated learning activities. For instance, student teachers reported that although they had not found theoretical studies concerning teaching practices and pupils' learning not as attractive as practical courses in the beginning of their studies, later many of them realised that theoretical studies or making lesson plans for teaching practicums could actually be interesting and inspiring. What triggered positive and activating emotions (e.g., enthusiasm, interest, or enjoyment) in those kinds of self-regulated and, particularly, co-regulated learning activities was the student teachers realising that utilising pedagogical theories in practice was possible, and using them to benefit their performance. Especially in CoRL incidents high-level and innovative teacher learning was reached in the teaching practicum and courses combining theory and practice.

Table 7. *The summary of key results in* Study II

- ➔ Most of the student teachers' self- and co-regulated learning incidents included positive and activating academic emotions
- ➔ Enthusiasm and enjoyment were the most often reported academic emotions in both self- and co-regulated learning activities
- ➔ Academic emotions were reported in all regulation phases
- ➔ Three main triggers of academic emotions in student teachers' self- and co-regulated learning experiences were found: 1) facing challenges, 2) social support, and 3) innovative learning and knowledge construction
- ➔ In CoRL all three triggers were typically found, whereas in SRL commonly one of the triggers was emphasized

Overall, the results from *Studies I* and *II* showed that student teachers' self- and co-regulated learning activities and positive activating emotions were strongly intertwined. The results also suggested that active self- and co-regulated learning triggering positive and activating emotions emerged especially in the natural teaching context in which student teachers were encouraged to innovative learning and teaching and constructing of new knowledge and skills, i.e., in *teaching practicum with pupils and peers*. These findings raised an interest to look more closely on what kinds of CoRL behaviours student teachers and pupils adapt in authentic classroom environment. In the next section the findings from *Study III*, in which student teachers' and pupils' co-regulated learning behaviours were analysed in authentic classroom interaction, are presented in more detailed.

4.3 CHARACTERISTICS OF STUDENT TEACHERS' AND PUPILS' CO-REGULATED LEARNING BEHAVIOURS IN AUTHENTIC CLASSROOM INTERACTION

In this chapter the results from *Study III* concerning the critical learning incidents including co-regulated learning behaviours are presented. The findings showed that in the critical learning incidents during classroom interaction both student teachers and pupils adapted active and intentional co-regulated learning behaviours. The results also showed that the positive learning incidents entailed co-regulated learning behaviours more often than the negative ones. From the positive learning incidents chosen for the final phase and deeper analysis, 81% included co-regulated learning behaviours, while co-regulated learning behaviours were utilised in 55% of the negative learning incidents that were analysed in more detail. In addition, two of the three ambivalent learning incidents including both positive and negative aspects entailed co-regulated learning behaviours. Student teachers' and

pupils' co-regulated learning behaviours entailed forethought and activation, monitoring and controlling learning, applying new strategies, and sometimes reflection of learning. However, there were some differences in student teachers' and pupils' co-regulated learning behaviours between the learning incidents student teachers considered either positive or negative 1) in student teachers' and pupils' verbal interactions and macro-level non-verbal behaviours; 2) when the incidents entailing co-regulated learning behaviours occurred during the lesson; and 3) in the focus and utilisation of different regulated learning phases.

4.3.1 THE INTERRELATION OF VERBAL INTERACTION AND MACRO-LEVEL NON-VERBAL BEHAVIOURS IN STUDENT TEACHERS' AND PUPILS' CO-REGULATED LEARNING BEHAVIOURS

Student teachers' and pupils' verbal interactions and macro-level non-verbal behaviours were closely related with each other and differed in terms of positive and negative learning incidents including co-regulated learning behaviours during classroom interaction. The positive learning incidents including co-regulated learning behaviours entailed student teachers' enthusiastic but calm behaviours as well as lively and in-task related interaction. Student teachers' non-verbal behaviours included active moving of the body typically in front of the classroom (e.g., pointing with hands), a lot of smiling, enthusiastic nodding, getting closer to pupils when asking them questions, and intense eye contact with the pupils. Also pupils showed their enthusiasm and interest, for instance, by eagerly raising their hands when the student teacher asked them questions. In terms of more private situations, (for instance, in discussion with pupils or when giving instructions in individual or group work), the student teachers tended to bend down to the pupils' "level" and establish close eye contact and pupils stayed calm and concentrated in those situations. Furthermore, typically the conversation and interaction was calm and concentrated among both parties and it resonated with the calm and harmonic behaviours.

In the negative learning incidents, student teachers' and pupils' non-verbal behaviours were typically tense due to the restless situations at that point of the lessons. The student teachers sometimes looked quite worried when time was running out and pupils were still working on the task. Also, their body language was typically tense and frenetic. In these situations, student teachers typically moved quickly back and forth in the class urging pupils to finish the task, while they still tried to convey the content of the lessons. There was also less eye contact with the pupils and student teachers smiled less than in the positive incidents. Also, pupils behaved restlessly, and often began to turn around in their own places or move about the classroom chatting and laughing

with each other or trying to get the student teacher's attention by their distracting behaviour. In many negative learning incidents, pupils' co-regulated learning behaviours were directed towards the student teacher and included demanding behaviours concerning the task, at which the student teachers replied quickly looking tensed when trying to keep the situation under control.

4.3.2 THE OCCURRENCE OF CO-REGULATED LEARNING BEHAVIOURS DURING THE LESSON

Some differences could be detected when the positive or negative learning incidents including co-regulated learning behaviours were situated during the lessons. The positive learning incidents were emphasised at the beginning (11) and middle (14) of the lessons, with only one occurring at the end. The negative learning incidents were more equally distributed throughout the lessons: five at the beginning, five in the middle and six at the end of the lesson. In the cases of the ambivalent learning incidents one was in the middle and one at the end of the lesson. Typical also was that the negative learning incidents were transitional situations at the middle of the lesson between the tasks, or when the task had to be finished at the end of the class (11 of 16 negative incidents had a transitional nature). Only one case of the positive learning incidents entailing co-regulated learning behaviours had a transitional nature. See below Figure 3 of the occurrence of co-regulated learning behaviours during lessons.

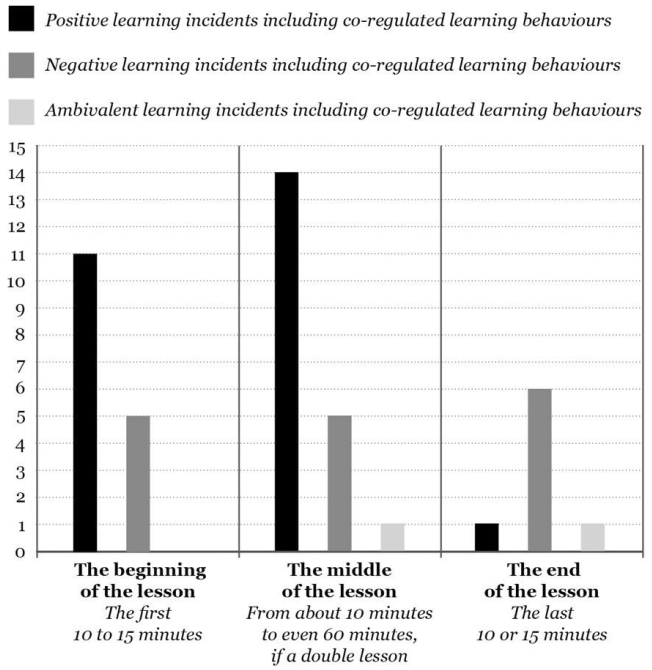

Figure 3. *The occurrence of co-regulated learning behaviours during lessons*

4.3.3 THE FOCUS AND UTILISATION OF CO-REGULATED LEARNING BEHAVIOURS BETWEEN THE POSITIVE AND THE NEGATIVE LEARNING INCIDENTS

Further investigation showed that there was a difference between the positive and the negative learning incidents including CoRL in terms of the focus of the co-regulated behaviours, which further resonated with the utilised co-regulated learning phases. The academic aspects of learning (i.e., related to the content of the task) were emphasised in the positive learning incidents involving co-regulated learning behaviours, whereas in the negative learning incidents, the social aspects of learning were highlighted (i.e., classroom management). The positive co-regulated learning incidents entailed various co-regulated learning behaviours characterised by a well-designed plan for introducing or carrying out the task. Typical of the incidents was that the student teacher was calm, strongly present, and enthusiastic towards the subject or task, which further triggered pupils' active engagement in co-regulated learning, such as forethought, monitoring, or even reflection. On the other hand, all the negative learning incidents involving co-regulated learning behaviours were characterised by a restless atmosphere in the classroom caused, for instance, by inadequate instructions given by the student teacher

or problems in time-management, which triggered the student teachers' reactive attempts to solve the problems, or complete the task as planned. Typical of these incidents was that both student teachers and pupils were monitoring and controlling the learning situation and were focused on managing the task. Accordingly, during the positive learning incidents, student teachers and pupils utilised co-regulated learning behaviours more diversely, with the emphasis being on forethought and activation, applying strategies as well as monitoring and control, and rarely reflection. In the negative learning incidents including co-regulated learning behaviours monitoring and controlling were emphasised.

Co-planning was utilised mainly during in the positive learning incidents and included student teachers' and pupils' forethought, activation, and analysing the forthcoming task. Co-planning during the positive learning incidents typically entailed introducing a new task or a new subject for the pupils at the beginning or middle of the class. Typically student teachers activated pupils to participate by asking questions, encouraged them to think aloud using their previous knowledge of the subject or task, or thought together how to carry out the task. An interesting topic and enthusiastic atmosphere created by the student teacher often further triggered pupils' lively forethought of the subject, which in turn gave new insights and questions for the student teacher to pose for the pupils. Typically most of the pupils were trying to participate in the conversation and gave their own comments and insights about the subject or the task. However, explicitly co-regulated goal setting and planning were employed only rarely in the critical learning incidents. Setting goals for the learning task and planning how to proceed were dominated by student teachers giving the information.

Co-regulated learning strategies were employed in both the positive and negative critical learning incidents during the lessons and dominated by both student teachers and pupils monitoring and controlling learning. In the positive learning incidents, applying new strategies was applied more often than in the negative learning incidents. In the positive learning incidents, for example, the student teachers monitored the learning situation and applied diverse strategies such as re-directing pupils' attention back to the subject or task in cases in which pupils were not concentrating. Student teachers were also sometimes innovative in difficult moments and able to view the task or the subject from a different angle or take on a different role. In the positive learning incidents, pupils were also engaged in monitoring and controlling the situation during the learning task. In particular situations, both student teachers' and pupils' co-regulated learning behaviours were generally more focused on the task at hand and on acquiring knowledge and learning new skills. On the other hand, in the negative learning incidents, monitoring and control were most commonly utilised to regulate pupils' unfocussed behaviours in the learning tasks, and to guide their behaviour back to the

learning task with other student teachers or with pupils. Student teachers, for instance, directed pupils towards understanding the instructions to complete a task or finishing the task if they were on the wrong track. Typical was that in many incidents, the pupils were strongly involved in monitoring and controlling each other's behaviour. In the negative learning incidents, student teachers applied strategies, for instance, by using quick solutions in restlessness situations when the pupils were not paying attention to the task at hand or had lost track or in finishing the ongoing task. These included student teachers' hands-on -strategies when helping individual pupils or a group of pupils. Furthermore, in both positive and negative learning incidents entailing co-regulated learning behaviours, monitoring and controlling were typically intertwined. For instance, noticing that someone answered incorrectly was followed by quick intervention from both either student teacher or pupils, i.e., a comment concerning the learning task or behaviour connected to learning.

Co-reflection was rarely employed in student teachers' and pupils' co-regulated learning behaviours. Furthermore, co-reflection was typically characterised by its retrospective nature, i.e., focusing on rehearsing what had been learnt or seeing if the learning task been conducted as it should have been, instead of explaining how to deepen or utilise the knowledge and skills acquired in the future. However, the few learning incidents including active and prospective (future-oriented) co-reflection on learning were characterised by an intense focus on learning in which both the student teacher and pupils were highly involved. In particular situations, co-reflection was characterised by pupils presenting spontaneous comments and questions about the learning topic that the student teachers further utilised as an opportunity to deepen the co-reflection by encouraging pupils to reflect on how to use newly-acquired knowledge also in their everyday life. Furthermore, the few learning incidents in which intense co-reflection occurred were characterised by versatile regulation activities, i.e., intentional co-planning by student teachers (e.g., forethought and activation) and co-strategy use (e.g., active monitoring and applying strategies). Those were also calm and joyful situations and student teachers were highly focused on facilitating the pupils' peer interaction. In the negative learning incidents, on the other hand, co-reflection typically occurred at the end of the lesson when pupils were behaving restlessly, were puzzled about what to do next, or were unsure if they had completed the task correctly. In particular situations, the student teacher tried to re-direct the pupils' attention to the learning task by asking questions about their progress or checking their understanding of the subject. However, both in the positive and negative learning incidents the co-reflection the student teachers and pupils applied were of a retrospective nature and concentrated on the overall progress of the learning situation, i.e., if the task had been conducted in a way that it had supported learning or if the learning task had been inspiring.

Furthermore, there were few negative learning incidents when pupils tried to reflect on what they were learning, or on what they had previously learned, in which their attempts were missed or even ignored by student teachers probably because of time-management problems.

The results also revealed that co-regulated learning behaviours in student teachers' and pupils' classroom interaction were typically spontaneous, overlapping, and fragmented. Only in a few learning incidents was co-planning clearly followed by co-strategy use; in most cases, co-regulated learning behaviours were utilised simultaneously, overlapped, or changed back and forth between co-planning and co-strategy use, and sometimes to co-reflection. On the other hand, there were also learning incidents in which only one dimension was displayed, for instance, monitoring or controlling learning. This was particularly typical during the negative learning incidents. Two authentic learning incidents from the lessons, one positive and one negative, can be found from the original journal article.

When summing up the results, in the positive learning incidents including co-regulated learning behaviours, the focus of learning was typically intensely on-task, co-regulated behaviours were utilised in a versatile way, and the student teacher's verbal interactions and non-verbal behaviours were calm and sensitive in pupils' regulated actions, comprising a well-structured and emotionally positive learning situation. On the other hand, in the negative learning incidents, the focus of learning was typically on task-management, co-regulation behaviours were more reactive and fast solutions, and verbal interactions and non-verbal behaviours were tense, comprising a restless situation causing a negatively toned atmosphere. Accordingly, the positive learning incidents during classroom interaction were characterised by a constructive friction occurring, meaning that the student teachers were able to construct and provide learning opportunities in which pupils were encouraged to participate and even outdo themselves in a challenging and positive learning atmosphere. On the other hand, the negative learning incidents included features typical of destructive friction in the learning situation, i.e., there was a mismatch between student teachers' and pupils' expectations about how the task should be conducted or finished, triggering demanding behaviours from the pupils' side and fast reactions from the student teachers. Still, common to both the positive and negative learning incidents was that co-regulation was reciprocal in student teachers' and pupils' behaviours, although in the positive learning incidents, co-regulation occurred in a more proactive and emotionally harmonic way. See Table 8 for the differences between different phases in either positively or negatively experienced co-regulated learning incidents.

Table 8. *The differences between co-regulation phases in positively or negatively experienced learning incidents in authentic classroom interaction*

Phases of co-regulated learning	**Co-regulated learning behaviours**	
	Positive incidents	Negative incidents
Preparatory (forethought & activation, task analysis, planning & goal setting)	Enthusiastic, lively interaction, encouraging, reciprocal task-focused	Student teacher –initiated rigid
Performance (monitoring, control & applying strategies)	Calm and concentrated, lively interaction, proactive and innovative, reciprocal, task- and learning-focused	Tense, reactive, reciprocal, management-focused
Appraisal (reflection of learning)	Calm, lively interaction, proactive, reciprocal, task- and -learning focused	Rigid, reactive, behaviour-related

Table 9. *The summary of key results in* Study III

- ➔ Verbal interactions and non-verbal behaviours were intertwined and resonated with the emotional atmosphere of the situation
- ➔ Positively perceived learning incidents including co-regulated behaviours were situated at the beginning or the middle of the lesson and in the on-task phase, whereas co-regulated negatively perceived incidents where typically transitional situations between the tasks
- ➔ In the positively experienced CoRL situations the co-regulated behaviours focused on the task, whereas in the negative situations, the focus was more on task-management
- ➔ Constructive friction characterised student teachers' and pupils' classroom interaction in positive CoRL incidents
- ➔ Common for both types of learning incidents was that CoRL was reciprocal in student teachers' and pupils' behaviours, however in the positive learning incidents in a more proactive and emotionally harmonic way

5. DISCUSSION

5.1 METHODOLOGICAL REFLECTIONS

In this doctoral dissertation, a qualitative multimethod approach with semi-structured interviews and video data was adopted in order to build a comprehensive understanding of how student teachers self- and co-regulate their learning and what kinds of academic emotions are connected to self- and co-regulated learning in the critical learning incidents student teachers experienced in different kinds of contexts of teacher education along their study path. In all three studies, qualitative content analysis was enriched by applying quantification, i.e., the qualitative data and analysis methods were clearly the overriding dataset, but the quantification of the qualitatively-constructed categories offered an opportunity to construe the results of the qualitative analyses further (e.g., Hesse-Bieber & Leavy, 2006; Maxwell, 2010; Sandelowski, 2001; Sandelowski et al., 2009). In qualitative research it is important to report the study processes precisely and discuss the results in terms of the *trustworthiness* of the study (e.g., Bengtsson, 2016; Elo, Kääriäinen, Kanste, Pölkki, Utriainen, & Kyngäs, 2014). This implies that along the whole research process, the researcher must engage with the qualitative perspective and the key is to pursue the rigor and credibility that will ensure that the results will be as trustworthy as possible (Bengtsson, 2016). Next the methodological procedures of the dissertation are discussed and evaluated through the lens of *credibility*, *dependability*, *transferability*, and *confirmability* (see Lincoln & Cuba, 1985).

Evaluation of *credibility* (i.e., validity) refers to meticulously demonstrating how the data and analysis procedures have been carried out (Bengtsson, 2016). In this dissertation, credibility in the data collection and analysis process was ensured by applying *methodological* and *investigator triangulation* (e.g., Denzin, 1970; Meijer, Verloop, & Beijaard, 2002; Miles & Huberman, 1994). Methodological triangulation, i.e., between method approach, was adopted by combining qualitative methods (semi-structured interviews, visualisations and retrospective narration and video data) and quantification of the qualitative results on student teachers' self- and co-regulated learning activities (*Study I*), academic emotions embedded in them (*Study II*) and student teachers' and pupils co-regulated learning behaviours during practicum lessons (*Study III*). In the *Studies I* and *II*, the qualitative interview data concentrating on the critical learning incidents enabled the student teachers to reflect their whole study path by bringing their own voice

and perceptions on their meaningful learning experiences as well as the emotional experiences embedded in them. In the *Study III* adopting the video-data on student teachers' critical learning incidents in practicum lessons enabled analysis of the actual co-regulated learning behaviours in student teachers' and pupils' classroom interactions. Accordingly, applying methodological triangulation and choosing complementary assessment methods such as semi-structured interviews and observations (i.e., video data), enabled capturing a rich view of student teachers' self- and co-regulated learning activities and academic emotions embedded in them and co-regulated behaviours along practicum lessons, and provided more detailed information on student teachers' self- and co-regulated activities in various learning situations during teacher education studies (e.g., Boekaerts, 2011; Hadwin & Oshige, 2011; McCaslin & Burross, 2011). Furthermore, utilising the quantification in several extents clarified the qualitative findings and gave for qualitative multimethod design *conversion legitimation*. Quantifying the frequency of self- and co-regulated activities student teachers adopted (*Study I*), the academic emotions embedded in them (*Study II*) and the frequency of student teachers' and pupils' co-regulated behaviours during practicum lessons (*Study III*) prevented the findings from becoming over or under weighted. This also showed both the regularities and peculiarities in the data that might not otherwise have been possible to be seen and helped to verify the interpretations made from the data (Patton, 1999; 2002; Sandelowski, 2001; Sandelowski et al., 2009). Also, investigator triangulation was utilised in the data collection to strengthen the credibility of the study (Archibald, 2016; Denzin, 1970). A contextually-modified version of the Teachers' Professional Landscape Inventory (TPLI) (used in *Studies I* and *II* (Ahonen et al., 2015; Soini et al., 2010) and Procedure of Guided Reflection (used in *Study III*) (Husu et al., 2008), were designed by the research group and several members participated in the data collection procedure. Pilot studies were carried out before the data collection and the instruments were further refined with the feedback received from the student teachers. Carrying out the pilot studies ensured that the both instruments were suitable for researching self- and co-regulation of learning (either the personal perceptions or overt behaviours) and academic emotions experienced in meaningful learning incidents in teacher education.

Credibility can also be evaluated by discussing the *inference quality* of the study, i.e., assessing *the design quality* and *the interpretive rigour* in this dissertation (e.g., Bengtsson, 2016; Tashakkori &Teddlie, 2003). In order to strengthen the design quality (i.e., the evaluation of the methodological rigour), features in student teachers self- and co-regulated learning were explored in three studies and with two cohorts of student teachers. The first study investigated on student teachers' self- and co-regulated learning activities and the second focused on academic emotions embedded in these

self- and co-regulated learning activities. The results from the first two studies guided to look more closely at how student teachers and pupils actually co-regulate their learning in authentic classroom interactions. Accordingly, expanding the doctoral dissertation to involve two kinds of data sets (interviews and video data) and two cohorts of student teachers at different stages of their teacher studies provided a more comprehensive understanding of student teachers as self- and co-regulating learners when learning to become teachers. Different datasets and participant cohorts were also beneficial for the cumulation of the key findings of the three studies: they supplemented each other and offered rich information that would not unlikely to have been obtained if only one kind of dataset or cohort of student teachers had been used (see e.g., McCaslin & Burross, 2011; Meijer et al., 2002). Also the abductive data analysis utilised increased the interpretive rigour in this dissertation (Tashakkori & Teddlie, 2003). The abductive analysis was adopted to strenghten the credibility in terms of the interpretations and their trustworthiness as the abductive analysis maintains a constant dialogue and reflection between the empirical findings and the theoretical presumptions in order to guarantee that the interpretations made from the data are as trustworthy as possible (e.g., Coffey & Atkinson, 1996; Levin-Rozalis, 2004; Kvale, 2007; Miles & Huberman, 1994; Morgan, 2007).

Dependability, (i.e., reliability) in qualitative research refers to precise reporting of the methodological decisions and careful descriptions of the analysis process which is typically evaluated through *transparency*: in this dissertation, both the data collection and analysis procedures have been described in a highly detailed way (O'Cathain, 2010; Bryman, Becker, & Sempik, 2008). The discussions between the members of the research group and independent parallel analysis of each study increased the dependability of the study. In *Study I*, the interrater reliability measured with Cohen's kappa (κ) in regard to the self- or co-regulated learning was 1.0, indicating complete agreement, and in regard to the phases of regulated learning was 0.74, indicating adequate agreement. In *Studies II* and *III* the overall agreement was 92 %. These indicates that a sufficient level of consensus was achieved between the coders. The precise analysis criteria used in the studies were described carefully and authentic citations from the original data offered in the original studies can be found at the end of this dissertation.

Transferability (i.e., generalisation) refers to how applicable the results are to other settings or groups (Bengtsson, 2016). In this dissertation, the participants and their selection for the study and the teacher education context in Finland were described in detail to increase *the inference transferability* of the results (Graneheim & Lundman, 2004). However, the student teacher data used in this dissertation were collected from two groups of student teachers from one Finnish university: student teachers at the end of their teacher education in *Studies I* and *II*; and at different stages of their teacher education

in *Study III*. Accordingly, due to the distinctive characteristics of teacher education in Finland, transferring the results to other educational contexts should be done with caution, and more studies with multiple methodological procedures are needed to validate the findings of this dissertation further. Regardless of these limitations, this study provides important insights about student teachers' self- and co-regulated activities during teacher education, looking closely particularly at the practicum periods (*Study III*). This suggests that the findings from this dissertation can be transferred to further research on student teachers as regulating learners, which also strengthens *the theoretical transferability* of this doctoral dissertation (Bengtsson, 2016).

Finally, the *confirmability*, i.e., evaluating the objectivity of the data and the analysis (Bengtsson, 2016) can be discussed through *communicative validity* (e.g., Kvale, 2007) and *ecological validity* (e.g., Bryman, 2004) of the study. The findings have been tested in frequent discussions within academia, including with the supervisors of this dissertation, the research group members and scholars at the university, during various seminars and conferences, as well as by the reviewers of the manuscripts related to the publication process of the study articles. Qualitative research typically also estimates *the pragmatic validity* of the results. This includes evaluating of the significance of the results for the academia and also if they can be applied in developmental practices (Kvale, 1995). The theoretical reflections and educational implications are discussed in more detail in sections 6.2 and 6.3.

5.1.1 ANALYSIS SPECIFIC REFLECTIONS

Interviews. Semi-structured interviews were used to analyse student teachers' self- and co-regulated learning activities (*Study I*), and the academic emotions embedded in them (*Study II*) during teacher education. Student teachers' meaningful learning experiences were investigated by use of the critical incident technique (e.g., Tripp, 2012) promted by the visualisations throughout their study path (e.g., Kress & Leeuwen, 1990), and were thus characterised by retrospective approach (e.g., Angelides, 2001; Cox & Hassard, 2007). When utilising interviews as a research method, there is a risk that participants might answer as they suppose the researcher wants hear (e.g., Ryen, 2008; Seidman, 2006), in terms of this study on regulation of learning and academic emotions. However, in the critical incidents protocol utilised in the studies, the participants were not asked about how they exactly had regulated their learning or only about their academic emotions, but questions were posed about their meaningful key learning experiences in order to promote rich explanations of the various learning processes and multiple emotions experienced when learning to become teachers (e.g., Järvenoja & Järvelä, 2005; Tripp, 2012). Furthermore, the visualisation method was

adopted as part of the interview to help the participants to recall the meaningful incidents and describe them; for instance, the learning activities utilised and emotions experienced in the learning incidents (e.g., Kress & Leeuwen, 1990). Thus, the visual object could be utilised as an aid to student teachers for them to comprehend different time points during their teacher education and tie their experiences to their academic journey. In fact, giving the participants the opportunity to reflect freely on their entire study path resulted in rich interviews in terms of descriptions of learning practices. Also, the quality and the origin of the academic emotions were described in detail. However, a limitation must be taken into account when using a retrospective approach: the learning experiences and emotions associated with them are always situated at a certain context and point of time as well as participants' overall life situation, and thus it might be challenging to recall and summarise these in an interview at the end of the study path (e.g., Angelides, 2001; Cox & Hassard, 2007). In addition, due to the retrospective approach, the learning activites and emotions participants recalled are reinterpreted memories of the learning situations and emotions embedded in them. This means that memory and reinterpretation effects might have influenced the data by generalising the experiences. Still, the retrospective method combined with the visualisations offered the participants a unique opportunity to reflect on their whole study path and resulted in very rich data. Furthermore, applying the critical incidents procedure is also beneficial to the participants: it has been proposed that personally meaningful learning experiences in teaching can be remembered retrospectively for years and going through them reflectively strengthens teachers' ability in their own professional evaluation (Tripp, 2012). Finally, the participants represented the student teacher population at the University of Helsinki sufficiently well in terms of age and gender.

Video data. Video data utilising the Procedure of Guided Reflection, i.e., critical incidents in teacher learning during practicum lessons (e.g., Husu et al., 2008; Tripp, 2012) was used when analysing student teachers' and pupils' co-regulated learning behaviours in *Study III*. As there has existed limited amount of research on how student teachers and pupils co-regulate their learning in the authentic classroom context, the methodological decision to use data in which their behaviours could be analysed over and over again, offered fresh insights on how they actually co-regulate learning during classroom interactions. By doing this, the dissertation contributes to the research field of co-regulated learning, as it is among the first to take a deeper look at student teachers' and pupils' actual co-regulated learning behaviours in authentic classroom interactions during a teaching practicum. However, the study has also several limitations. In *Study III* precisely considered and well-established data selection was a fundamental methodological decision: although the data set included enormous amounts of video material, only certain parts (meaningful learning incidents reported by student teachers)

were taken and used in deeper analysis (see e.g., Derry et al., 2010). Concentrating in the critical learning incidents resulted in an intense and eventful set of data, including the highlights and challenging situations during the practicum lessons. Still, the length of these incidents, varying from a couple of minutes to 20 minutes means that a large section of the data, probably including active co-regulated learning behaviours, was left out of the analysis. However, choosing to look closely on the critical incident chosen by student teachers, made the study design coherent in this dissertation as critical and meaningful learning incidents are also at the core of *Studies I* and *II*. Furthermore, video data are vulnerable in terms of the quality of the recordings (e.g., Luff & Heath, 2012). Also in this study the data from six student teachers were left out the deeper analysis due to the poor sound quality on the videotape, a noisy and restless situation in the classroom, or quiet face-to-face situation between student teacher and pupil, which made the transcribing the verbal interaction impossible. There were also nine student teachers from whom only positive (seven students) or negative (two students) incidents were analysed more deeply due to the poor sound, and losing possibly valuable data including active co-regulation of learning can be considered as a limitation. Finally, in *Study III* the participants represented the student teacher population at the University of Helsinki sufficiently well in terms of age and gender.

5.2 ETHICAL REFLECTIONS

This doctoral dissertation was conducted by following the ethical guidelines specified by the Finnish Advisory Board of Research Integrity (2012) for the responsible conduct of research. This was guaranteed by integrity, carefulness, and accuracy when recording, presenting, and evaluating the research results. Furthermore, all three studies were conducted without causing any harm to the participants involved in the studies. The anonymity of participants was carefully guaranteed, and they were treated respectfully in all three studies and in the summary of the doctoral dissertation. The privacy of the participants was highly preserved: all the personal information and direct identifiers were removed from the reported results and the participants could not be identified from the text. In terms of the student teacher cohort in part-studies I and II, the research consent was granted by the Faculty of Education at the University of Helsinki. Consent to participate in the video study in *Study III* was received from the school authorities of the school district, the case schools' teachers, the student teachers, and the the pupils' parents. The participation in all three studies was voluntary for both the student teachers and pupils, and there was no additional compensation for participation. In addition, the participants had the option to withdraw from the study at any point of the process. To conclude,

this doctoral dissertation was faithful to the ethical values of honesty and accuracy at every point of the research process (see e.g., Steneck, 2007).

5.3 RESULTS IN THE LIGHT OF PREVIOUS LITERATURE AND THEORETICAL CONTRIBUTION

In this doctoral dissertation student teachers' self- and co-regulated learning activities, the academic emotions embedded in them and student teachers' and pupils' co-regulated learning behaviours in authentic classroom interaction during teaching practicums were investigated to provide a better understanding of how student teachers utilise self- and co-regulation of learning. Results from the three studies offered new insights and enriched previous research on teacher learning by: 1) showing that self- and co-regulated learning is part of active and meaningful student teacher learning and examining the relationship between student teachers' self- and co-regulated learning, 2) detecting the reciprocal relationship between self- and co-regulated learning and positive academic emotions, 3) identifying differences and similarities between self-reported and behavioural regulation of learning, and 4) detecting the characteristics of teacher education supporting active self- and co-regulated learning.

First of all, the results suggested that the incidents student teachers' experienced as being highly meaningful in terms of their professional learning included active and diverse regulation activities, individually, and especially with others. Previous research on student teachers has neglected the importance of student teachers' ability to individually and socially regulated learning and there has been a limited number of prior studies particularly on co-regulation of learning among student teachers (See e.g., Endedijk et al., 2012; 2014; Heikkilä et al., 2012; Hwang & Vrongstinos, 2002; Järvenoja & Järvelä, 2009; Järvenoja et al., 2017; Kramarski & Michalsky, 2009; Malmberg et al., 2015; Perry et al., 2004; 2006; 2008; Tillema & Kremer-Hayon, 2002; Vrieling et al., 2010; 2012). However, high-quality teacher learning through which the *development of*, for example, teacher thinking (e.g., Clark & Lambert, 1986), the sense of professional agency (e.g., Heikonen, Pietarinen, Toom, Soini, & Pyhältö, 2019) and teacher identity (e.g., Beauchamp & Thomas, 2009), as well as *the ability to* reflect on teaching (Gelfuso & Dennis, 2014; Wubbels & Korthagen, 1990) are emphasised, call both for regulating one's own learning during teacher education and co-regulating peers' and pupils' learning in demanding social situations. Thus, the results shed light not only on *what* student teachers should learn, but also on *how* they learn during their studies both individually and in collaboration with others.

Accordingly, the results showed that active and intentional CoRL is a crucial part of becoming a teacher. Although SRL activities were reported more often, were the incidents including active CoRL perceived as being highly meaningful and instructive learning experiences, providing tools for one's own learning and learning and teaching with others (*Study I*). Learning to become a teacher and their future work typically takes place in a demanding social environment; student teachers need to learn how to regulate themselves and others at the same time, i.e., co-regulate learning. In Finland, teachers typically have a high-level of autonomy and the self-regulated learning skills are needed in teacher profession. In recent years, co-teaching and team work have increased due the new curriculum that emphasises both collaborative learning and self-directed learning of pupils (Finnish National Board of Education, 2014; Finnish National Agency for Education, 2017). This calls for teachers' co-regulation skills. Futhermore, the ability to self- and co-regulate learning has been found to be connected in the well-being experienced by pre-service and in-service teachers', suggesting that CoRL skills are also at the core of active and sustainable teacher development (Soini et al., 2010; Väisänen, Pietarinen, Pyhältö, Toom, & Soini, 2018). Also, previous research on SRL has suggested that the social environment and the relationships between student teachers, peers, and teacher educators build a base for the ability to utilise regulation in learning and teaching among the range of contexts of teacher education (Endedijk et al., 2012; Michalsky & Schecter, 2013; Perry et al., 2006; 2008). The results of student teachers experiencing CoRL incidents as highly instructive experiences offering space for high-quality learning, supported the theoretical view in which CoRL is suggested as a mediating process that will enable individual regulation skills to flourish as well as active regulation in the learning situations with others, which may at its' best, reach even highly complex but instructive and creative learning process such as socially shared regulation of learning (SSRL). The findings further imply that the concept of CoRL fits well in the teacher education context because it considers the learners from a range of positions and backgrounds still learning simultaneously. That is, student teachers, teacher educators, and pupils share the social realities of teacher education and school life as different level learners. Furthermore, previous studies on the regulation of learning, either on student teachers or pupils, emphasised the importance of internalising the individual regulations skills (Endedijk et al., 2012; Hwang & Vrongstinos, 2002; Kramarski & Michalsky, 2009; Michalsky & Schecter, 2013; Perry et al., 2004; 2006; 2008; Vrieling et al., 2012). The results from this study, however, supports the application of collaborative learning methods not only for improving SRL skills: CoRL seems to enable higher-level cognitive processes, and thus promotes student teachers' thinking skills and higher order learning, both in theoretical studies with peers and teacher educators and in pedagogical situations with pupils. The findings from this dissertation suggests the

importance of co-regulation as an enabler of both self-regulation to flourish and develop, but also as a valuable process that offers collective learning space for even complex and deep learning processes. Figure 4 (below) illustrates the theoretical view of CoRL as a learning process in which regulation phases can be flexibly regulated together when aiming and supporting both individual and even shared learning goals. It is a hypothized model desingned based on the previous literature, such as Hadwin et al., 2011, Schoor et al., 2015 and the results from this dissertation.

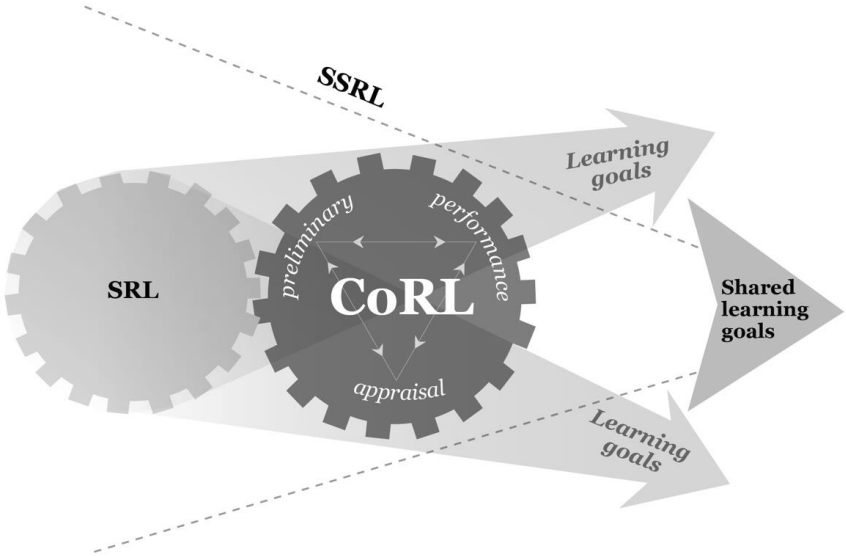

Figure 4. *The mediating process of co-regulation of learning*

Secondly, further investigation showed that student teachers' ability to regulate themselves and others was closely intertwined with academic emotions embedded in the learning situation, especially with the positive ones. First of all, the results showed that both self- and co-regulated learning were typically reported in the positively experienced learning incidents and there were only a few negative learning incidents including self- or co-regulated learning (*Study I*). This result suggested that there is a link between self- and co-regulated learning activities and emotionally positively-toned learning incidents. Drawing on a valence and arousal framework of academic emotions, the findings confirmed that student teachers reported mainly *positive activating* and *achievement oriented* emotions in learning incidents including self- and co-regulated learning (*Study II*) (Pekrun 2006; 2013; Pekrun et al., 2002; 2007). Furthermore, in terms of classroom interactions during teaching practicums, the situations student teachers had perceived as positive typically had been concentrated and calm including seemingly enthusiastic behaviours

and interactions in the lesson, whereas the negative ones were characterised by restless and tense behaviours in the classroom (*Study III*). However, over half of the negatively-perceived incidents included co-regulation of learning (*Study III*). This implies that negatively-toned learning experiences do include regulation of learning, but from retrospective point of view (*Studies I* and *II*), the descriptions of the learning activities situation included narrows due to the negative emotional tone.

Results also revealed that actively regulated learning triggers achievement emotions, and particularly *activity* emotions, such as enthusiasm, enjoyment, and interest, both in self- and co-regulated learning, and typically accross the regulated learning phases (*Study II*). However, there were some slight differences between SRL and CoRL activities and related academic emotions in different learning phases. SRL seemed to trigger positive activating emotions throughout the regulated learning incident, even in the preparatory learning phase. In CoRL, on the other hand, positive emotions often occurred during the performance or appraisal phases. For instance, successfully implemented group work or teaching lessons with peers in teaching practicums engendered positive activating emotions when shared learning experiences were monitored during the learning situation or reflected on afterwards. Student teachers sometimes experienced a sense of inadequacy in SRL during strategy use and monitoring as well as in the reflection, while during CoRL this occurred only in goal setting and task analysis. This might imply that although CoRL may cause problems at the beginning of the regulation cycle when group dynamics are being negotiated, it offers social resources and enables higher level cognitive processes for problem solving during strategy use. Furtermore, setting shared goals for learning and co-planning might create emotional and cognitive challenges for the group members, which might hinder the positive activating emotions at the beginning of co-regulated learning tasks (Järvelä & Järvenoja, 2011). Findings revealed that regulated learning triggered enthusiasm in the reflection phase in both self- and co-regulated learning, suggesting that actively regulated reflection is future-oriented and adaptive in nature (*Study II*). Student teachers reported mainly positive and achievement oriented activity emotions in learning situations involving active self- or co-regulated learning. This indicates that high investments in the challenging and personally valuable learning tasks combined with high control and value given for the situation, triggered positive activating emotions, especially *enthusiasm* (e.g., Hascher & Haganauer, 2016; Keller et al., 2014; Pekrun, 2006; Rowe et al., 2013; Timoštšuk, et al., 2016). A high number of incidents involving enthusiasm in student teachers' actively self- or co-regulated learning incidents is promising since it indicates that they are highly motivated, committed, and professionally engaged. Furthermore, the results showed that active SRL and CoRL was associated with experienced enthusiasm (*Study II*) as well as

displayed enthusiasm (*Study III*). Teachers' experienced and displaeyd enthusiasm has been shown to be one of the key factors in effective and high-quality teaching (e.g., Keller et al., 2018; Kunter et al., 2013) and related, for instance, in pupils' enjoyment and interest experienced while learning (Frenzel et al., 2009; Keller et al., 2014). In Finland student teachers are highly selected student group typically having strong motivation and appreciation of their future profession during their studies, but students in some other countries reported emotions that might not have been as positive (Anttila et al., 2016; 2017; Timoštšuk & Ugaste, 2012). The extraordinary status of the teaching profession in Finland and the high-quality master's-level teacher education might thus affect the positive result on reported academic emotions in both SRL and CoRL.

In particular, CoRL incidents were emotionally very rich, i.e., included a richer set of emotions within learning incidents than self-regulated learning incidents. Three triggers of academic emotions experienced in student teachers' self- and co-regulated learning incidents, i.e., facing challenges, social support, and innovative learning and knowledge construction were all typically involved in CoRL incidents. Accordingly, the results confirmed that the social environment, including support offered by teacher educators and peers and self- and co-regulatory elements (e.g., achievement- and control-related) are sources of positive emotions in learning (*Studies I* and *II*) (Hascher & Haganauer, 2016; Rowe et al., 2013; Timoštšuk, et al., 2016). This finding implies that learning together in challenging but socially supported learning situations offers a shared space for higher-order cognitive processes, and through that, emotionally rich sources for teacher development. CoRL was found to have its own emotional challenges and multiple persons and goals also triggered negative emotions, but if they could be over-comed, the mutual experience of being succesful seemed to enrich and deepen the emotional experience.

Thus, the findings from all three studies suggest that active self- and co-regulated learning and positive and activating academic emotions construct a circle in which both strengthen each other (see also Pekrun et al., 2002; Pekrun & Linnenbrink-Garcia, 2012; Webster & Hadwin, 2015). The combination of emotions experienced in actively regulated learning situations further accumulates meaningful learning experiences and well-being, which potentially have long-term effects in teacher development and the construction of professional agency (e.g., Heikonen, Pietarinen, Pyhältö, Toom, & Soini, 2017a; Heikonen et al., 2019; Kostiainen et al., 2018; Väisänen et al., 2017). In addition, the results also suggest that with whom learning is regulated with (or without, i.e., independently) and the constructive support offered in the learning situation might mediate the academic emotions that "take over" in the situation (*Studies I*, *II*, and *III*). Since self- and co-regulated learning are very demanding learning processes, they both require that it is

possible to utilise cognitive capacity effectively (see e.g., St Clair-Thompson & Gathercole, 2006; Kaplan & Berman, 2010; Moos & Pitton, 2014). The findings of this dissertation study suggests that others can act as a resource in challenging learning situations and CoRL was experienced as being meaningful, instructive, and positive exprerienes partly because of the support and presence of peers, teacher educators, and pupils in the situation, which triggered mutual learning to a deeper level that would perhaps not have been reached without the others involved in the situation.

Thirdly, different datasets in this dissertation offered rich insights on how student teachers utilised regulated learning phases, i.e., preparatory, performance, and appraisal. Results showed that student teachers utilise all regulatory learning phases quite evenly, ranging from the planning phase to performance and finally to reflection, and thus both self- and co-regulated learning included the common components (*Study I*). The emphasis of each element was quite similar between and within self- and co-regulated learning confirming that successfully self- or co-regulated learning included conscious planning and goal setting, active controlling, monitoring and utilising different learning strategies while learning, and reflection during the incidents if a change needed to be done.

The results however suggested that during authentic classroom interaction, regulated learning phases moved back and forth during the situation and were thus utilised flexibly (*Study III*). In fact, in successful and positively-perceived situations in the classroom, the regulated learning phases were utilised in a highly versatile manner (e.g., goal setting, and activation, monitoring, controlling and using strategies, and sometimes reflection) and proactively, but also non-linearly in student teacher - pupil -interaction. Further investigation of CoRL in classrooms showed particularly "hands-on" regulation phases were emphasised, for instance, activation of previous knowledge in the preparatory phase and control in the performance phase (*Study III*). Regulation activities that are considered to be cognitive mechanisms, such as goal setting, planning or reflection of learning did not emerge as often in student teacher - pupil classroom interactions, which on the other hand, were frequently reported in student teachers' personal learning experiences (*Study I*). However, monitoring was realised in student teachers' classroom behaviours. The reason why some elements of CoRL, especially control, were often detected, might be because it is seemingly a behavioural regulation: participants in the situation make a clear verbal or non-verbal behavioural effort to keep the focus on the task, whereas planning, monitoring, and evaluation (i.e., reflection) have been seen as cognitive regulation, at least across regulation models (see e.g., Rogat & Linnenbrink-Garcia, 2011). However, the findings suggested that when student teachers and pupils adopted co-regulated learning behaviours, they both monitored the learning situation and reacted rapidly, for instance, by applying a new strategy

(typically student teacher initiated behaviour) or by controlling the learning situation (in which both student teachers and pupils were active). One reason why co-performance, especially control, was emphasised over co-planning and co-reflection might be that the former enables keeping the focus on the task, while the latter activities are more future-oriented. Furthermore, the results revealed that co-performance was divided into two kinds of strategies: those that were more mechanical and focused on tangible behaviours connected to learning task (control), and those that were more creative and focused on cognitive aspects of learning, i.e., rapidly figuring out new ways to understand the subject being learned or to test a new way to figure out the subject. The both strategies require active monitoring. In addition, co-reflection was identified in student teacher-pupil -co-regulated behaviours, although it was rarely applied. Reaching deeper levels of co-reflection would require student teachers to be alert in terms of actively adapting reflection in classroom practices and in engaging pupils to reflect on what they had learnt, how it was learnt, and how learning could be improved in the future.

Furthermore, a reason for the difference between student teachers' personal descriptions and their actual behaviour in classroom might be the use of retrospective narration utilised in the former. It might be that when a person is recalling a meaningful and critical learning situation experienced during teacher education, it is told as a story with a beginning, a middle, and an end, which strengthens the appearance of chronical order of regulated learning phases. Such chronical order of how regulated learning is constructed and how it should progress is also emphasised by many regulation models (see e.g., Puustinen & Pulkkinen, 2001). However, previous studies on student teachers' regulated learning during teacher education have found that regulated learning activities are quite fragmented in nature (Endedijk et al., 2012). The results in this dissertation also showed that in a constantly changing classroom environment, the phases of regulation moved back and forth during both the positive and negative incidents (*Study III*). This confirms the over-lapping and fragmented nature of co-regulated learning behaviours (e.g., Rogat & Linnenbrink-Garcia, 2011). The results further supported the findings from some of the previous studies, implying that regulation of learning in authentic classroom interactions and with multiple persons and interests in the situation does not "bend" on strict orders and progression, but lives and breathes with the needs of the situation.

However, how actively and purposefully self- and co-regulated learning can be employed in learning situations seems to be dependent on the regulation skills participants in the learning situation have (especially in terms of the more capable ones in CoRL) and how emotionally sustainable the situation is, i.e., is there a higher risk of the learning situation being disturbed because of uncertain goals or lack of support in a particular teacher education course or in teaching practicums. Results also implied that particularly co-

regulation of different processes and phases of regulation of learning enables higher cognitive processes further taking learning experiences to a deeper level and seems to support socioemotionally positive learning opportunities and constructive friction in learning (*Studies I* and *II*). The findings also showed that positively perceived learning incidents included more versatile and proactive co-regulated learning behaviours in student teacher – pupil -interaction than the negative incidents (*Study III*). CoRL in the positive incidents was characterised by diverse regulation activities concentrating on the regulation of content understanding and the learning task, whereas negative learning incidents entailed regulation that concentrated on the behavioural aspects of learning. Previous research on, for instance, socially shared regulation in collaborative group work suggest that more versatilely the group members were able to utilise different dimensions of regulation processes, the better the group's learning outcomes and emotional atmosphere among group members were (Rogat & Linnenbrink-Garcia, 2011). This same synergy was also detected in the student teachers' and pupils' co-regulated learning behaviours in classroom interaction. The incidents including active and versatile co-regulated learning behaviours, typically took place in positive incidents, and more one-sided co-regulating behaviours typically situated in the negative ones. This is in line with previous research suggesting that successfully co-regulated or shared regulated groups tend to utilise different regulatory processes for different purposes and in a richer way (Rogat & Linnenbrink-Garcia, 2011; Volet et al., 2009).

Accordingly, the results suggested that it is possible to engage pupils in high-level co-regulated learning behaviours, when the learning situations includes transparent and clearly verbalised regulation opportunities which trigger pupils' engagement in the regulation of learning creating socioemotionally positive classroom interactions (*Study III*) (see also Rogat & Linnenbrink-Garcia, 2011; Wesling et al., 2017). Findings on student teachers' and pupils' co-regulated behaviours during classroom interaction also indicate that the tricky moments when the new task is being introduced and transitions throughout the lessons often determined if the situation was experienced in a positive or negative way by student teacher. Student teachers' reactive attempts to re-engage restless pupils with the task easily resulted in co-regulated behaviours becoming less reciprocal or they changed in to external regulation, or lack of regulation (see also Heikonen, Toom, Pyhältö, Pietarinen, & Soini, 2017b; Westling et al., 2017). This might further cause negative emotions in the student teacher, which might further strengthen negative emotions among also the pupils (Pekrun, Muis, Frenzel & Goetz, 2018). The findings showed that the restless atmosphere in the classroom can also evolve easily when conducting the task, as occurred in many positively perceived learning incidents, i.e., not only in transitional situations as was typically the case in the negatively-percieved incidents. However, if the

student teacher was able to utilise proactive co-regulation strategies and re-engage pupils with the task and getting the situation under control with the pupils, it triggered a positive emotional tone about the situation and successfully perceived learning situation in teacher learning (*Study III*). Furthermore, results showed that the student teachers' capacity to be creative when the situation requires it, combined with holding tightly the aims set for the learning, was characteristic for pupils' co-regulated behaviours and engagement in the learning situation (*Study III*). This implies that the regulation of learning should be intentional and goal-oriented (e.g., Pintrich, 2004), but also flexible and context-sensitive in order to reach the optimal level for each learning situation. Accordingly, the findings of the all three studies imply that active and successful self- and co-regulation of learning requires high investments and commitment, but also pliability, in the learning situation, not only "in mind" (cognitive and metacognitive level), but also in behaviours, i.e., "putting oneself/oneselves on the line".

Fourthly, the findings from the studies suggest that teacher education learning enviroment where instructional and emotional support is offered in carefully-constructed and positively but typically challenging learning situations, provide the key to active self- and co-regulated learning. Combining pedagogical practical knowledge with theoretical ideas (e.g., in teaching practicum) was often referred to as triggering self- and particularly co-regulated learning (*Study I*). The challenges provided by teacher educators and peers promoted student teachers to actively regulate their learning. The three main triggers (facing challenges, social support, and innovative learning and knowledge construction) of the emotional experiences that were embedded when student teachers' self- or co-regulated their learning in the meaningful learning experiences, suggest that situations for active regulation include aspects that combine social support and demands for high-quality teacher learning (*Study II*). Furthermore, there were many positively-perceived learning situations that concentrated on complex tasks or subject understanding, all of which had the potential to end in chaos (*Study III*). However, if the student teacher was capable of utilising co-regulation (e.g., monitoring, controlling, applying strategies, and /or reflection) by either being sensitive to pupils' regulation attempts or involving pupils in co-regulation, the atmosphere changed into a positively coherent and highly engaged learning situation with active co-regulation behaviours. Involving and being sensitive to pupils' behaviour and responding to pupils' initiatives to engage in regulation in challenging learning situations was the key for either positively or negatively- toned classroom interaction.

Thus, the results suggested that the learning situations characterised by constructive friction between skills and support, such as facing and overcoming challenges (e.g., *Study I*), or the construction of deeper pedagogical knowledge and skills with peers or pupils (e.g., in *Studies I* or *III*)

typically in teaching practicums, entailed SRL or CoRL. The constructive friction challenged the student teachers to expand their previous knowledge and skills in a positively experienced learning environment. The findings imply that this kind of constructive friction experienced when learning triggers active self- and co-regulated learning (see e.g., Vermunt & Verloop, 1999) that can be created by providing both a challenge and support (Rajuan, Beijaard, & Verloop, 2008), which can lift CoRL to a more active level. Teacher educators and peers provide a central resource for this. Accordingly, findings confirm that if university students' skills and challenges set for learning are high and balanced, they will trigger actively regulated learning and positive emotional experiences (Inkinen et al., 2014; Timoštšuk et al., 2016). Similarly, in classroom interactions student teachers' displayed enthusiasm, encouragement and support offered for pupils promoted co-regulation in student teacher-pupil –interaction. The findings thus imply that active self- and co-regulation supporting emotionally optimal learning is grounded in providing constructive challenges and genuine support for learning during teacher education.

Accordingly, the results imply that several kinds of co-regulated learning activities, both in terms of emphasising the role of a more capable one as well as learners at more equal level, have their functions in the high quality and meaningful learning in teacher education. The results flowing from this dissertation suggest that varied qualities of co-regulation serve as a prompt for internalising SRL (Hadwin & Oshige, 2011; Hadwin et al., 2011) and also in lifting the quality of learning to a cognitively and motivationally higher level. However, co-regulated learning typically involved a more capable one (e.g., a teacher educator or student teacher) who was highly engaged in promoting co-regulated activities in terms of both guiding the learning (i.e., were involved in goal setting, monitoring, use of strategies, and reflection) and building constructive friction in the learning situation in the positively experienced learning incidents during teacher education, particularly in classrooms in teaching practicums. Hence, the role and importance of the "more capable one" in well-constructed and successful co-regulated learning seemed to be in many situations a central feature in enabling high-quality co-regulated learning. Moreover, the finding also suggested that those involved in CoRL can have different aims set for the learning while sharing the process. Yet maintaining the balance between providing constructive encouragement and giving space for students to overcome challenges, and with either being overbearing, or on the other hand, neglecting them is a huge challenge both for teacher educators and future teachers themselves.

To sum up the results from this dissertation the findings suggest that emphasising learning of individual regulation as the core skill of learning throughout different levels of education is not the most reasonable thing to do in terms of active and high-quality leaning, but encouraging the use of co-

regulation of learning is. This does not mean that learning of self-regulation skills would not be important: it is still one of the purposes in co-regulation process (Hadwin et al., 2011; Hadwin & Oshige, 2011) and is an important skill in the teaching profession which requires also high autonomy and fluent self-regulation skills. However, with goal-oriented CoRL, self-regulation skills emerge as by-products, but as the results of this dissertation suggest should CoRL practices, and in fact, recognising that there is in many cases need for the more capable one, be in the core of high-quality teacher learning. Accordingly, the findings from this study suggest that "co-regulated learning is the new black", not learning the self-regulated learning skills per se. In many situations learning with others helped student teachers' learning to reach deeper levels and triggered positive academic emotions combining a highly meaningful learning experience and thus indicated that CoRL offers a fruitful ground for high-quality teacher learning.

5.4 EDUCATIONAL IMPLICATIONS

Based on the findings from this dissertation, some educational implications can be made that might be useful in supporting student teachers' abilities to adapt self- and co-regulated learning in teacher education, and thus further in their work as teachers. First of all, the results of the dissertation imply that student teachers' should learn how to self- and co-regulate their learning at different stages of the learning process and find out what the positive effects are in it in order to be able to understand how important it is to use these skills during their studies and in the future in teachers' work. Thus, in addition to the theoretical awareness of regulated learning, student teachers should learn how to actually use self- and co-regulated learning practices from the beginning of their studies and in various teacher learning enviroments calling for individual and social learning skills. This can be reached by first strengthening teacher educators' knowledge of the principals of self- and co-regulated learning and their skills to adapt regulted learnig practice in their work. Accordingly, teacher educators should be encouraged to integrate regulated learning practices into teacher studies by designing courses that could be built round principals of regulated learning. These tangible changes would benefit student teachers' skills to adapt self- and co-regulated learning, both in teacher education and in schools. Learning to use systematic, goal-oriented, and reflective regulation of learning from the beginning of teacher education would not only help student teachers' meaningful and active teacher learning and their well-being as teachers but also benefit the learning of their peers, i.e., future colleagues, and their pupils (see e.g. Väisänen et al., 2017; 2018). However, active self- and co-regulation are complex processes and their actual adaptation when learning cannot be taken for granted: they

require knowing how these processes are utilised in practice and, of course, a lot of actual practice and repetition in various learning settings of teacher education. The persistent efforts regulated learning requires are challenging to maintain for almost everyone, but regulating learning together seems to offer advantages: if one in the learning situation "fails", others can keep the course straight. Also, the results from this dissertation suggested that in student teachers' co-regulated learning incidents, learning reached cognitively more complex levels, probably because there were multiple agents engaged throughout the learning process. However, many participants in the learning situation is far from being solution in itself for problematic situations: it is crucial that clear goals are set for learning and genuine will to reach them together, i.e. skills to regulate learning together. Co-regulation might be easier for the participants who, based on their backgrounds, are fairly homogeneous, e.g. student teachers in their teacher educations studies, even with teacher educators. In these cases co-regulation can be consider to be a high-quality, possibly even reaching genuine and demanding socially shared regulated learning. In classrooms there is larger gap between student teachers and pupils and unless a student teacher is highly aware and keen to involve pupils in co-regulation, or sensitive to pupils' attempts, the regulation might change in to external or other regulation. The results from this dissertation imply that it is possible to achieve good quality and genuinely co-regulated learning in classroom interaction with pupils, and student teachers should be more aware that classrooms are the place to learn and experiment with different kinds of pupil-centred methods. It seems that many children, and in fact also the grown-ups, would benefit if they could co-regulate and thus support and guide each other's learning with the regulation activities: what is the goal, how can it be reached, what to do in problematic situations and finally reflect on the whole learning situation. Accordingly, the results of this dissertation also underlined that in many learning situations there is still a need for positively demanding and encouraging a more capable one, altough CoRL activities also seemed to be succesful among learners at more equal levels. Furthermore, the results imply particularly the importance of learning co-regulation skills during teacher education because they are suggested to mediate both the learning of SRL as well as the socially shared regulation skills. In addition, co-regulation skills promote Finnish student teachers' abilities to engage their future pupils in both in self-directed learning as well as collaborative learning practices which are both emphasised in the national curriculum (Finnish National Board of Education, 2014; Finnish National Agency for Education, 2017).

Secondly, student teachers' use of self- and co-regulated learning in their studies, abilities in encouraging pupils in actively regulated learning or being highly attentive to their regulation attempts in teaching practicums cannot be taken for granted, even if these skills were systematically taught in a regulated

manner. In fact, sensitivity to adapting self- and co-regulated learning practices can be a challenging task even for experienced teachers. The hectic and challenging reality of school life with pupils coming from wide range of backgrounds with multiple needs, also sets challenges in adapting co-regulation activities in practice. Accordingly, focusing on learning requires executive functions processes, i.e. cognitive control processes that strongly mediate, for instance, attention and memory (see e.g. St Clair-Thompson & Gathercole, 2006; Kaplan & Berman, 2010). To be able to stay attentive and to acquire new knowledge are demanding processes for everyone and especially for young children. There is tentative evidence that executive functions and regulation of learning share the same resources when learning which implies that in some situations these processes might deplete each other (Kaplan & Berman, 2010). Results in *Study III* also showed that for the beginning teachers, noticing and taking into account all the processes affecting their pupils' concentration and regulation might be quite demanding. For instance, pupils with special needs require carefully constructed and systematically expressed regulation behaviours to be able to engage in them. Furthermore, it is not self-evident that student teachers are naturally skillful self- and co-regulators when they are just taught the principles of regulation. Student teachers themselves might have problems with simultaneous concentration on the specific learning task and regulation of learning, or they might experience strong cognitive load in teaching practicum, which then influences how they are able to provide possibilities to participate in regulation of learning. Therefore, it is important that active self- and co-regulation are not only part of teacher learning in various learning environments in teacher education, but that special support will be offered to those student teachers who experience challenges in adapting regulated learning practices. This could be provided through intentional co-regulation practices in teacher education.

Thirdly, the dynamics of regulation of learning and academic emotions should be a more integral part of teacher education and consciously taken to be a part of teacher education programmes. That is to say, student teachers would also benefit from the awareness of how academic emotions influence their own and pupils' learning and learning the tools about how to use regulation of learning when constructing an emotionally positive learning environment. The teaching profession and situations in schools might be emotionally burdening for novice teachers, who might experience feelings of inadequacy which further causes turnover intensions (Heikonen et al., 2017a). Tangible, active and conscious reflection of learning and teaching situations as well as recognising the emotions experienced in these situations should be among the key factors in teacher education. Co-reflection is an important skill to be learned in teacher education, because it raises awareness of a range of learning processes (e.g., successful or challenging) and provides tools for developing all regulation phases (e.g., also goal setting and strategy use). Thus,

the importance of educating future teachers to be able to recognise their emotions emerged in an academic situation and regulating them efficiently cannot be underestimated. This could help them to learn how to be more flexible in using co-regulated learning strategies with pupils, even in typically challenging and emotionally burdening learning situations in schools. Life can never be pure joy and negative emotions are part of learning: previous research suggests that negative emotions experienced in the learning situation have both negative and positive effect on learning (Ketonen & Lonka, 2012; Litmanen et al., 2012; Timoštšuk et al., 2016). If prolonged, they have been shown to hinder cognitive activity as the attention is attached in surviving and getting through the learning situation, but on the other hand, experiencing anxiety before test has shown to improve learning outcomes among student teachers (Ketonen & Lonka, 2012; Litmanen et al., 2012; Pekrun et al., 2002; Timoštšuk, et al., 2016; Webster & Hadwin, 2015). In addition, it has been shown that experiences of anxiety may not be harmful for the learner if the emotion still supports the long-term learning goals (Tamir, 2009). The results from this dissertation suggested that it is crucial for teachers to learn how to build constructive friction in learning and through that positive learning environment. Results further showed that active self- and co-regulation of learning triggering positive, achievement and activity oriented, academic emotions seems to be beneficial for meaningful and deep teacher learning underlining the importance for them for future teachers.

Finally, the findings from this dissertation revealed that there is a particular mechanism in the interplay between self- and co-regulated learning and positive academic emotions, which suggests that it would be beneficial for student teachers to be supported in learning regulation skills. The findings from this study suggest that when a student teacher is able to stick with the goals set for learning, reaches the goals and reflects on the learning, as its best with others and in positive and supportive learning environment, and thus feels capable in overcoming possible challenges getting a feeling of being successful, efficient, and competent (i.e., reaches sense of professional agency), are positive academic emotions triggered. This is a process that is worth reaching for as this interplay of actively regulated learning and positive achievement, especially activity, emotions is a key for meaningful teacher learning and teacher development, and through that also for pupils' learning (see also Timoštšuk, et al., 2016). Accordingly, it would be wise in teacher education to pay special attention in supporting student teachers learn what regulated learning is, and how it can be used in learning and teaching, but also to give them tools to recognise their basis as novice teachers and give them confidence as future teachers. This is offered by giving to them knowledge and space to understand that skilful teaching includes actual learning and teaching skills, self-awareness, and sense of competence, which *can be* improved by learning to adapt self- and co-regulated learning practices in the challenging

learning environment teachers faces consciously, actively, and in a manner which is goal-oriented.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Although this dissertation started to elucidate the dynamics between student teachers' self- and co-regulated learning as well as between self- and co-regulated learning and academic emotions, and finally on student teachers' and pupils' actual co-regulated learning behaviours in authentic classroom interaction, it also raised many new questions that could be looked at more profoundly in the future research on these particular topics. The previous studies on student teachers' regulation of learning have typically concentrated on precise regulation processes, either in their self-regulated learning (e.g., Endedijk et al., 2012; 2014; Heikkilä et al., 2012) or shared regulated learning in particular courses or in specific regulation dimension in collaborative learning situations (e.g., on regulation on motivation see Järvelä & Järvenoja, 2011, or on emotions Järvenoja & Järvelä, 2009). Therefore, in the future, studying the spectrum of student teachers' self- and co-regulated learning activities and on their interplay in various contexts of teacher education and in the dynamic relationship of student teaches' regulation of learning and academic emotions would be interesting. There has also been a limited amount of research on student teachers' and pupils' regulation processes in teaching practicums.

First, it would be interesting to do more research about student teachers' and pupils' co-regulated learning and on the development of their co-regulated learning processes, such as during a practicum period. Accordingly, this could be investigated longitudinally as well as utilising both video data and stimulated recall interviews. Focusing on a teaching practicum would offer a wider perspective on the student teachers' and pupils' co-regulated learning behaviours. Moreover, in this research design student teachers' and *pupils'* own perceptions of the co-regulated learning behaviours they use during lessons could be studied. It would also offer the option to look the dynamics between self-regulation and co-regulation processes in classrooms, i.e., simultaneously how student teachers and pupils perceive their personal regulation activities and how the effects these have on co-regulated learning within each other. Furthermore, using these data, i.e., video data enriched with the STR-interviews would give an opportunity to do research on the academic emotions connected to self- and co-regulated learning in student teachers' and pupils' authentic classroom interaction.

Secondly, student teachers' individual study paths as self- and co-regulating learners through their studies into working life, i.e., *a person-oriented approach* could be adapted to see the differences between profiles

student teachers comprises in terms of their self- and co-regulation abilities and how it affects in transition points when starting to work as professionals. This kind of study design would offer valuable information from both student teachers having fluent regulation skills and from them having problems with their regulation skills in order to develop teacher education to support various kinds of learners.

Thirdly, *an intervention* study in which student teachers regulation skills would be conciously developed in theoretical course or in a teaching practicum would provide valuable tools for how to develop teacher education to be able to support student teachers to become active self- and co-regulators in multiple contexts of teacher education.

Finally, this study looked at the self- and co-regulated learning activities student teachers adopted in their critical learning incidents experienced during their teacher education at a more general level (*Study I*), and although more deeply in terms of co-regulated behaviours (*Study III*), would more elaborated studies be needed *on specific regulation dimensions* (e.g., on motivation, emotions, cognition, or behaviours) among student teachers in various learning contexts and within different regulation processes (self-, co-, and shared).

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APPENDICES

Appendix A The semi-structured student teacher interview

Introduction for the interview

Today we are going to go through your experiences during teacher education and thoughts regarding teachers' work.

The interview data will be treated confidentially, and only the members of the research group will handle it. Also the identity of the participants will be protected, and they cannot be identified from the reported results.

The interview is divided into three parts: first I will ask you for some background information, then we will discuss your experiences during teacher education and at the end I would like you to reflect on your future work as a teacher.

I I as a teacher and my teaching experience

1. What kind of teacher qualification will you receive after completing your teacher education? Are you studying to become a primary school teacher or a subject teacher?

2. What made you want to become a teacher?

3. How much experience do you currently have about teachers' work? Do you have any other teaching experience in addition to compulsory teaching practice included in teacher education programme? If so, what kind of experience and how much experience do you have?

II Perceptions of your own agency in teacher education

4. Your will graduate soon. What are your thoughts concerning teacher education, and how do you feel regarding your studies?

5. Describe and visualise your learning path in teacher education to this paper. The image may be a timeline or other suitable way to describe the study path. Mark the significant events of your study path on the visualisation. The situation may be:

-positive/inspiring or negative/frustrating situation
-a single encounter with a person or a longer course / study period, during which you have learnt something essential for your future work.

The following questions are support questions for visualization-based interviews. Each event was recalled by addressing these questions.
- What happened? Can you explain more about the event? Who was there?
- What made the event particularly significant?
- What changed during the event (thought or activity)? What did you think first? How did your thoughts change after the event? What made you change your thought or actions? How did you feel?
-What did you learn about teachers' work and being a teacher?
- How typical / atypical was the study situation you described? If the situation was atypical, what is the typical learning situation in teacher education?
-In addition to the above-mentioned situations, do you have in mind any longer episodes that influenced your thoughts of being a teacher or alternatively, situations that in a surprising and quick way influenced your conceptions of being a teacher?

6. Have your thoughts changed during the teacher education? If so, how? Would you describe briefly how your thoughts have changed during your

study path? What did you think in the beginning of your studies, and what do you think now?

7. How would you describe teacher education from a student's perspective? How is the studying here? Describe a typical day of studying, and what happens during the day?

8. How do you think that a teacher educator perceives the learning environment? How is the everyday work of teacher educators here?

9. How would you describe a typical situation learning situation in teacher education? What happens? What does the teacher educator do? What do the student teachers do?

10. Which of your strengths has the teacher education supported?

11. Were there challenges / questions / issues that you wondered about regarding your future work as a teacher? If so, where do you get support at the moment?

12. Do you think that teacher education should be further developed? If yes, how? What should be done to reach that aim you just described?

III Perceptions about teacher's professional agency in primary school

13. What is the everyday life in schools like from a teacher's perspective? Describe a typical work day. What happens during the day?

14. What is the everyday life in schools like from a pupil's perspective? Describe a typical school day. What happens during the day?

15. You are almost a qualified teacher. What do you consider your core tasks as a teacher to be? Why? How do you act in order to achieve your goals and to fulfil your core task?

16. Describe a typical lesson in your future class. What will happen? What does the teacher do? What do the students do?

17. How do you perceive the importance of the professional community for your future work?

18. How would you like a) your pupils b) the parents c) the headmaster and other teachers to describe your working as a teacher?

19. Do you think that primary schools should be improved further? If yes, to what direction? How would we get into a situation you described?

20. Is there anything else that you would like to tell me or clarify further?

Thank you!

ARTICLE 1

Saariaho, E., Pyhältö, K., Toom, A., Pietarinen, J., & Soini, T. (2016). Student teachers' self- and co-regulation of learning during teacher education. *Learning: Research and Practice*, 2(1), 44-63.

ARTICLE 2

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ARTICLE 3

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